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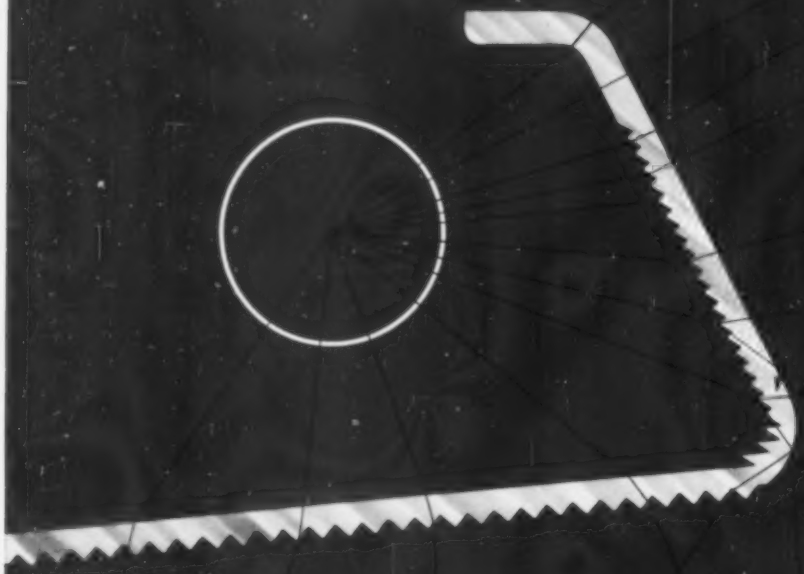
DECEMBER 1961

ILLUMINATING ENGINEERING

Journal of the
ILLUMINATING ENGINEERING SOCIETY

in this day of Prismatic Light Control



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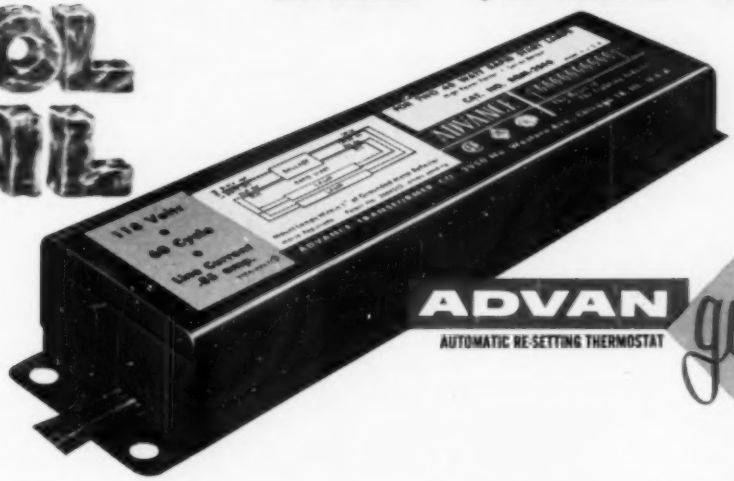

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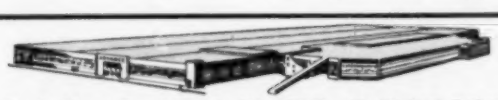

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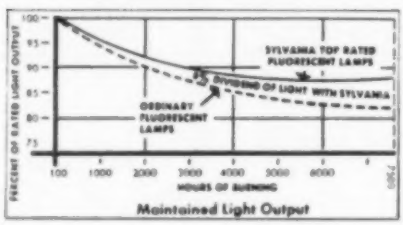

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THE JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY

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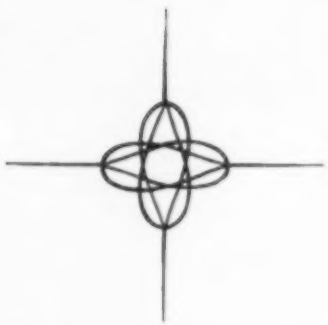

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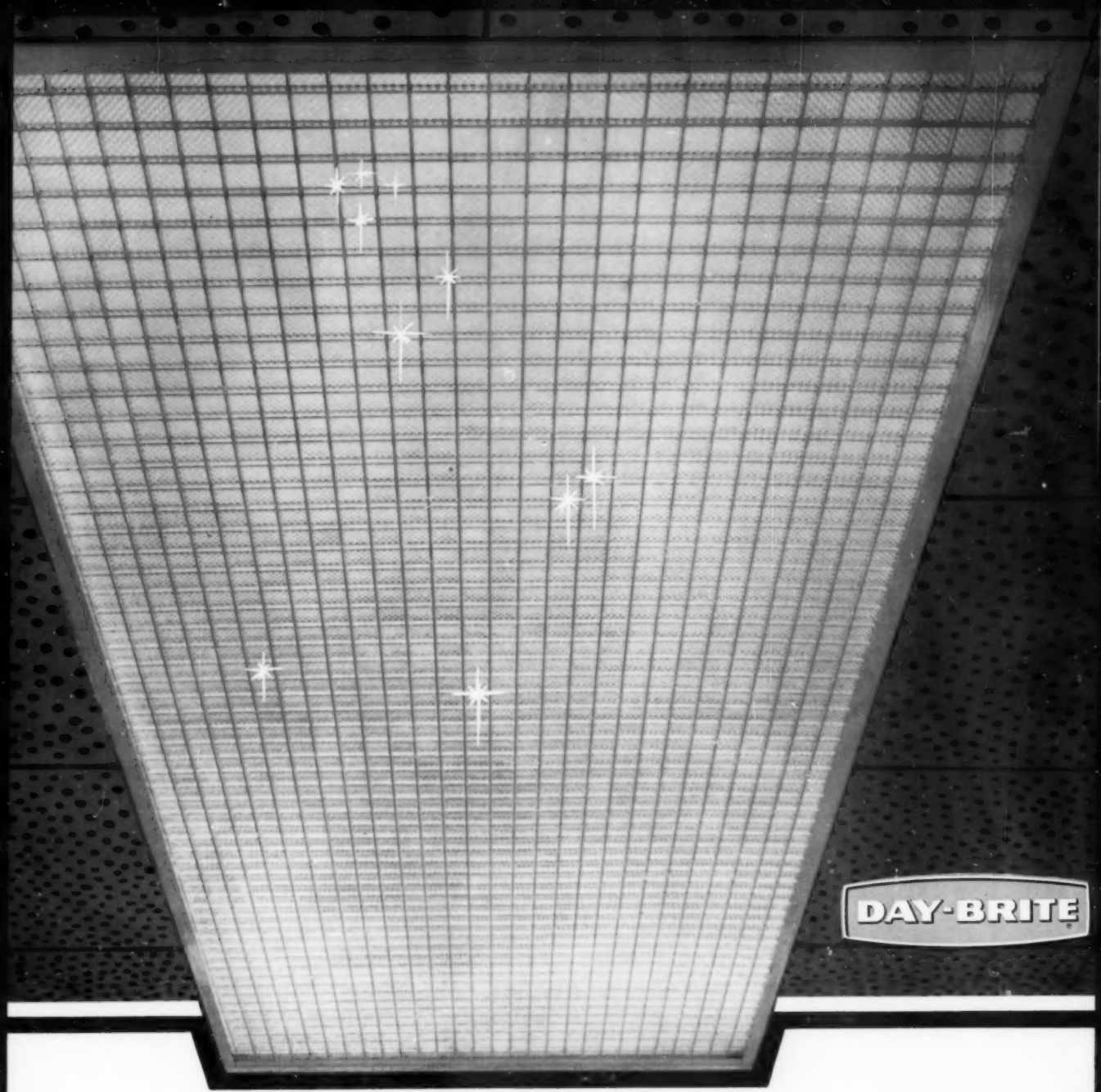

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ARTFUL RESTAURANT LIGHTING

long recognized as an indispensable tool for creating elegant dining atmosphere, has achieved one of its most notable expressions in Patricia Murphy's Candlelight Restaurant, Ft. Lauderdale, Fla. Here, the masterful use of lighting as a major design element and the unifying decorative motif, is the single most important reason for the success of the interior design.

Recessed downlights in randomly scattered ceiling panels create effect of starry night in atrium.

VICTORY OVER the high mortality rate of restaurants (of the 20,000 opened each year, only half survive*) demands an artful combination of superlatives—in food, service and decor. If the architectural and interior designs of Patricia Murphy's Candlelight Restaurant reflect the quality of the food and service, the restaurant should enjoy a well-deserved longevity.

Located on the Bahia Mar Yacht Basin in the rapidly growing Ft. Lauderdale resort community, Patricia Murphy's has been designed to heighten the holiday mood of its vacationing patrons. All design features—the lush tropical foliage, a central atrium with fountain, glass-walled dining rooms, a curtain of crystal spheres, a wall of colored glass discs—have been joined to create an elegant dining atmosphere.

To enhance the distinctive interior design, lighting has been planned to create a world of multiple reflections, surrounding the diners with sparkle. Completely integrated with the interior and exterior designs, the illumination was intended to express a related series of transitions from one area to the next and create a continuity of space within the whole complex of shops and dining areas that comprise Patricia Murphy's.

Architecturally, the Candlelight Restaurant was planned so that each of the three dining rooms, the cocktail lounge and two shops have at least one full glass wall. Thus, the lighted tropical gardens surrounding the restaurant complex become part of the decorative plan, linking the interior with the exterior.

ENTRANCE TO Patricia Murphy's is through a foyer roofed with a series of canopies formed from pipe and covered with stretched white canvas. Glass walls backed by decorative aluminum pipe grilles, frame the entrance, which provides a transition from the yacht basin to the dining areas. Lighting for the entrance foyer is indirect, from 150R/FL lamps in cylindrical housings mounted on the canopy support poles.

Directly behind the entrance lies the central atrium which leads to the four principal restaurant areas. The fountain, Moorish arches and grilles, and wall of plantings decorating this area set the mood for the elegant interior decor. Basic lighting in the atrium, which serves to enlarge the space, is from a series of adjustable projector and reflector

*_Interiors Book of Restaurants_ by William Wilson Atkin and John Adler.

lamps, mostly 75-watt sizes, some with pale-colored filters, and all fed from trolley duct concealed behind the arches. To accommodate variations in size, color and form of the changing floral displays, the lighting system in this area was planned to permit maximum flexibility in locations and aiming of light sources.

ATRIUM ceiling lighting, one of the most successful uses of illumination as a wholly decorative element, is a subtle simulation of a starry sky. Essentially, the ceiling is composed of perforated metal, one-foot square panels, backed by sound absorbing material and painted midnight blue. To obtain the effect of sparkling stars, twenty-five panels, each containing two recessed flush downlights with clear, miniature, 12-volt lamps were scattered by the interior designer among the solid panels. The optical system—a seven-sided specular Alzak reflector—produces the multiple specular images which simulate stars. The lamps in the ceiling panels are operated at below rated voltage to increase life.

CENTRAL feature of the atrium, a recirculating water fountain, is illuminated from a single narrow beam spot lamp recessed above a deep anodized black aluminum cone. The unit houses a reflector lamp with clear lens and shielded filament. Rated maximum candlepower of the lamp is approximately 90,000. The ten-degree beam spread directs the light so that the principal jet of the fountain is sharply defined without an obvious source of illumination.

From the atrium, one enters the Crystal Room (page 669) which derives its name from the dominant Maria Theresa chandelier, but obtains functional lighting from a more modern technique. Relatively unobtrusive, randomly placed downlights with 2½-inch apertures and medium distribution through a lens system, are recessed above a striped pink velvet ceiling to provide illumination for menu reading and dining. To obtain the desired illumination from this system, downlights were first arranged in a rectangular grid to produce eight to ten footcandles maintained, then moved in the reflected ceiling plan so that no straight rows of apertures were apparent. The Patricia Murphy trademark, a hurricane holder with candle on each table in the room, adds a note of intimacy to the elegant decor.

BETWEEN THE Crystal Room and Garden Room is the decorative highlight of the restaurant —a curtain of crystal spheres, suspended on chrome plated chains, and lighted to create a series of multiple reflections in both dining rooms. Linear sources, consisting of reflector showcase lamps behind a lens system which provides an asymmetric distribution, are installed on both sides of the curtain, to cover it with light from top to bottom. At their highest lighting level, these fluorescent strips may be used to illuminate the models at a fashion show; during normal dining hours they are dimmed so as not to overpower the effects of other lighting in the area.

Functional lighting in both the Garden and Candlelight Rooms is provided by downlighting, designed to appear unobtrusive in relation to the decorative lighting elements. In the Garden Room, decorative lighting is from moderately-sized chandeliers, mounted around the perimeter of the

Garden Room viewed from Crystal Room through curtain of crystal spheres. Table candles and small crystal chandeliers add highlights and sparkle to the atmosphere.

room. Reflecting in the glass walls of the dining room, these units add further sparkle to the over-all lighting environment. The Candlelight Room is decorated by a wall of multi-colored glass Rondelays, transilluminated by asymmetric lens units concealed in the recess behind the seating area. The lighting effect achieved is a reasonably uniform illumination distribution across the vertical plane of the glass.

The total success of this unique restaurant design is a tribute to the imagination and complete cooperation of the lighting designer, interior designer and architects. If further proof were needed for the advantages of integrating illumination design from the blueprint stage, this restaurant would supply it.

Henry Wald, Wald & Zigas, Consulting Engineers, New York, N. Y., designed the lighting for this restaurant. The installation won first prize in the New York Section's Applied Lighting Competition and placed second in the Northeastern Regional contest. Interior design is by Edmund Motyka, AIA; architects were Leavitt & Henshell, both of New York.

Decorative highlight of Candlelight Room is transilluminated wall of colored glass Rondelays. Room derives its name from candlelight chandeliers circling the columns and candle table decorations.

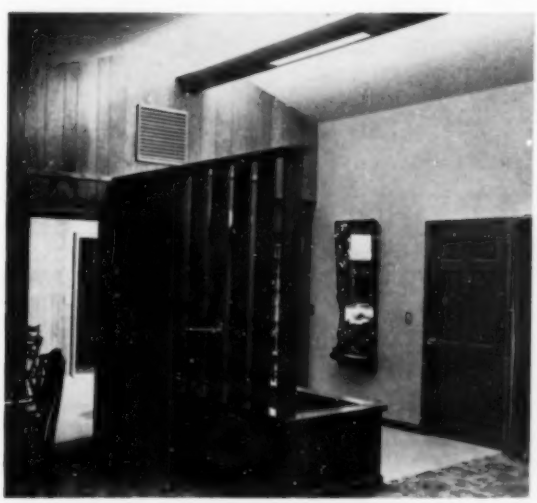
Small crystal chandeliers around perimeter of Garden Room reflect in glass walls for decorative sparkle. Functional lighting is from unobtrusive, randomly placed, recessed downlights. Visible in background, at right, behind crystal curtain, is large chandelier which dominates Crystal Room.

Structural Home Lighting

THE DECORATIVE distinction and ample illumination benefits of structural lighting in residences are vividly demonstrated by three lighting elements which were designed for the model home at the Oregon State Fair in Salem. While these units formed only part of the illumination design for the model home—planned to educate the Oregon fair-goers—they are presented here for their interest and usefulness to illuminating engineers, interior and lighting designers. The model home, lighted to Medallion standards inside and out, demonstrated good illumination principles to some 50,000 visitors at the Fair.

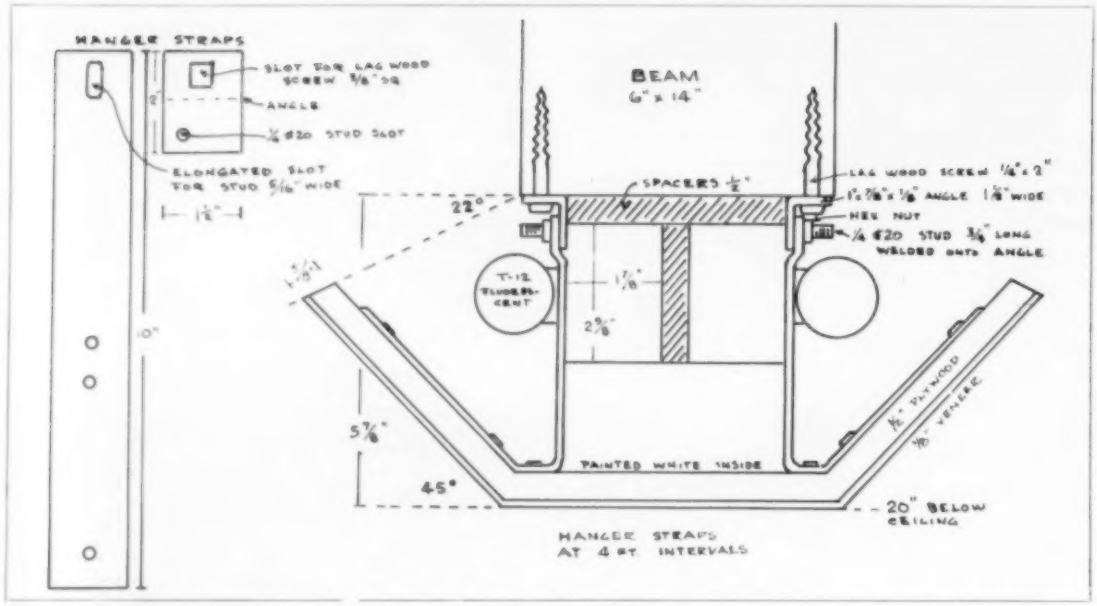
LIGHTING TROUGH

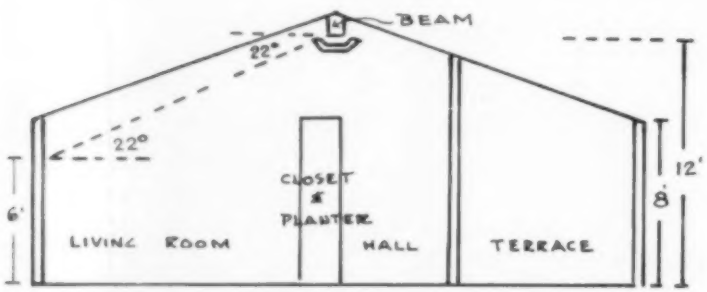
One basic lighting element, designed to supply indirect general illumination for the living room, dining room and entry hall of the home, was a 14-inch-wide trough suspended from a 12-foot ridge beam for the entire 25-foot length of the area. Lamped with two rows of deluxe warm white rapid-start fluorescents, five 40-watt and one 30-watt placed end-to-end in each row, the trough provided 75 lumens per square foot of general lighting. A four-foot section, fitted with ⅛-inch, .53 transmission Plexiglas, provided downlighting in the



Downlighting section of trough.

Trough viewed from living room.





Detail of lighting trough; cross section, above, elevation at left.

hall and highlighting on a room divider/planter.

The trough itself, shown in detail above, was constructed in three eight-foot sections for ease in handling. Fabricated of half-inch plywood, it was faced with ⅛-inch veneer, and painted white inside for high reflectance.

Installation of the trough was completed in four stages. First, parallel rows of fluorescent strips, with half-inch spacers above and between, were attached to the underside of the beam so that the lamps would be oriented sidewise. Next, the top sections of hanger straps were attached to the beam, at four-foot intervals, on the outside of each channel with sturdy wood lag screws. Hanger straps were ⅛-inch thick angle iron, 1½ inches wide. Bottom sections of the hanger straps were bolted to the bottom and wings of the trough to hold it firm at the joints and prevent it from warping. Finally, the trough was lifted into place, section by section, the tops and bottoms of the hanger straps bolted together and the lamps installed in the previously mounted strips.

LIGHTED CANOPY

Integral with the architectural design of the home was a lighted overhang built above the eating bar between the family room and kitchen This lighting element, resembling a wide cove, was attached to a soffit 12 inches below the ceiling to form a canopy over the kitchen cabinets. The shielding media, 12-inch wide, ⅛-inch white Plexiglas with a transmission factor of .53, was inserted at the bottom of the unit and supported by strips of metal T-bars on all sides. Equipped with two 30-watt homeline fluorescent sources, placed end-to-end and attached to the soffit at the back of the canopy, this custom-built unit furnished pleasantly diffused downlighting on the snack bar, uplight on the ceiling and an attractive decorative effect.

SANCTUARY

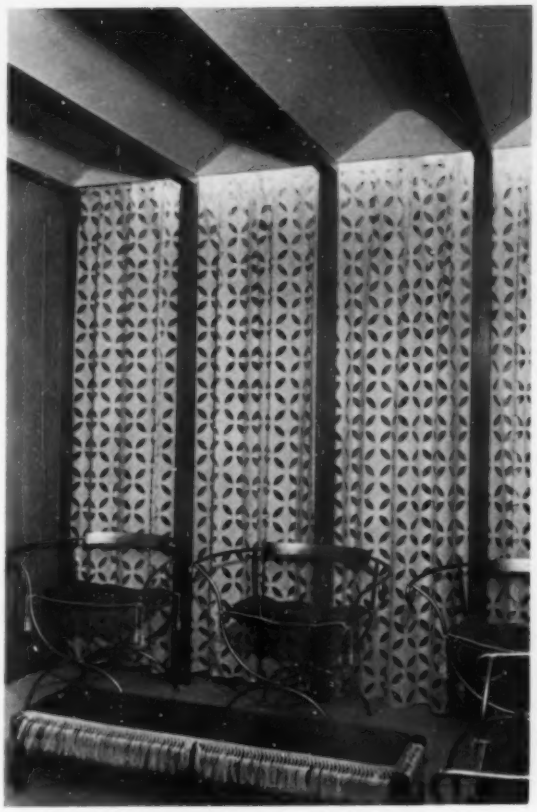
A particularly effective demonstration of the psychological effects of lighting was obtained from the illumination design used in the "sanctuary."

Located in the bedroom wing of the home, this eight- by ten-foot room was lighted and decorated to create a quiet place for meditation. Visitors who lowered their voices noticeably upon entering the room did not require further proof of the subliminal properties of illumination.

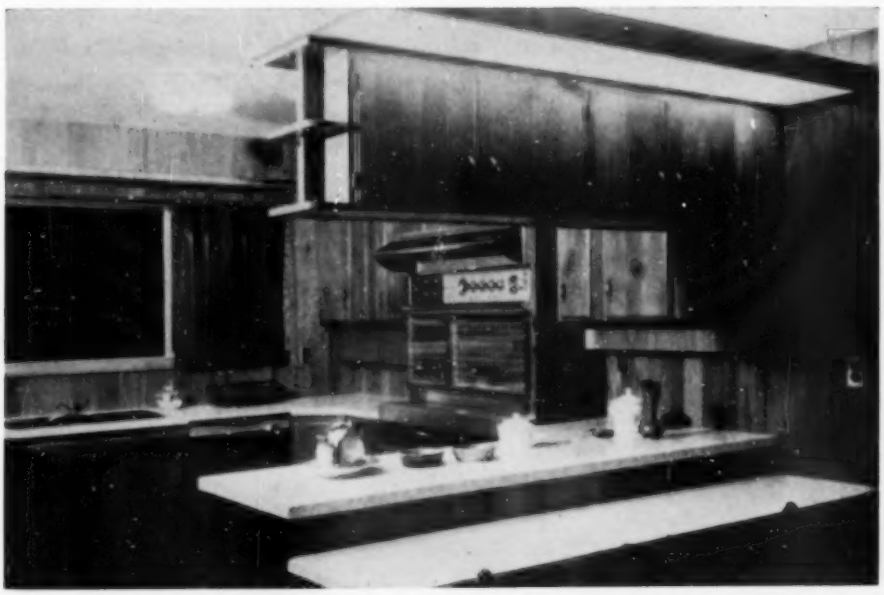
Physically, the sanctuary was constructed with a ceiling resembling the arched roof of a church, and furnished with a kneeling bench and chairs painted gold and fitted with crimson velvet cushions. Against the wall opposite the window, was an altar-like structure (not visible in photograph) which held a large, open Bible.

A soft glow of light was introduced into this room from a six-foot cornice constructed above the window Filtered through the gold silk curtains and white, cut-work, felt draperies, this subtle illumination enhanced the meditative atmosphere of the room. Cornice lighting provided 33 lumens per square foot of general illumination in the sanctuary. An additional 20 lumens per square foot for reading light were obtained from a suspended, ceiling-mounted fixture installed above the "altar."

These lighting elements were designed by Grace Schoeni, Portland General Electric Co., Portland, Ore., as part of her illumination plan for the Oregon State Fair model home. The complete installation tied for fourth place in Class I of the National Applied Lighting Competition.



Cornice lighting in sanctuary.



Canopy illuminating snack bar between kitchen and family room has four-inch shielding lip and white Plexiglas diffuser. General lighting in kitchen (visible in background) is provided by decorative opal glass unit equipped with three 50-watt inside-frosted lamps. A six-foot cornice with two 30-watt homeline lamps mounted over the sink and a two-foot shielded fluorescent strip over the counter provide additional lighting in work areas.

A Mountain Tunnel how to light it

An appalling accident record in this relatively new (1952) tunnel has been reversed by complete relighting. A new approach entirely, based on IES Recommended Practice for Tunnel Lighting, was required.

If ever "functional lighting" must be functional, it would be in a long highway tunnel. Here it could be a matter of life or death. On those terms, the "lighting" in the Queen Creek Tunnel in Arizona was practically a trap. In daytime especially, the tunnel's entrance was a black hole in the mountain; its exit a huge haze of glaring sunlight; and in between, its darkness was barely dispelled by widely-spaced incandescent units. After ten accidents and two deaths in relatively short order, tunnel relighting was undertaken.

"Modernization" in this case meant *correction*—to IES standards. First to be corrected were the walls themselves. The original finish was a Portland cement grout which was used as a surface filler. Reflectance apparently didn't enter into its specification. Brand new it might have been about 30 per cent RF; at the time of relighting (after five years' use) reflectance was nil.

Tile or other high reflectance materials were not practicable, due to construction problems, so tests were run to determine the best possible alternative for lining the tunnel. The walls were cleaned to the bare original surface, and painted test stripes were applied to evaluate wall reflection factors over a period of time. Results of these tests indicated that two coats of white vinyl paint would provide a minimum reflectance of 70 per cent. The time tests showed that normal periodic cleaning would maintain this desired reflectance of walls and ceiling.

Similar testing and analysis was applied for other factors of the installation, and literature thoroughly researched.[1-5] Illumination levels required throughout the length of this particular tunnel were thus determined First, the tunnel

This installation was engineered by Harold Stead, Econolite Corp., Los Angeles, Calif. At the time of the installation, Mr. Stead was Traffic Supervisor (Signal and Illumination), Arizona Highway Department. The job won first prize in the Arizona Section and Intermountain Regional Applied Lighting Competitions, and placed fourth in the National Competition.

length of 1219 feet was "divided" into four separate zones, and lighting designed for the needs of each of these four parts.

One: Daylight transition entrance zone, 60½ feet. No lighting was provided here due to the reflected or direct sunlight entering this zone.

Two: High-intensity lighted entrance zone, 364½ feet. Design level here was calculated at 98 footcandles initial and 75 footcandles average maintained.

Three: Medium intensity transition zone. Design level was calculated at 49 footcandles initial and 37 footcandles average maintained.

Four: Low intensity zone (center section) 219 feet. Design level was calculated at 25 footcandles initial and 18 footcandles average maintained.

This same design applies again in reverse as the motorist approaches the opposite portal entrance zone area.

For nighttime lighting, the level of illumination is consequently lower than for daylight; thus a transition lighting system was provided. The night illumination level in the tunnel was designed for four footcandles.

Queen Creek Tunnel

	BEFORE	AFTER
Portal Entrance	7.5 fc	120 fc
Center of Tunnel	2.5 fc	24.5 fc
KW Demand	41	58
Wall-Ceiling Reflectance	0-5%	70%

Analysis of several types of equipment finally fixed on plastic-shielded direct type of three-lamp (fluorescent) luminaires. Surface mounting is in continuous rows on each side of the tunnel, 14½ feet above the roadway, which is just below the truck exhaust area. This relatively low mounting of double units per side, mounted and aimed at a control point of the roadway area, provided the required footcandle level and distributed the light output from the fixtures in a ratio roughly of 55 per cent upward (to walls and ceiling) and 45 per cent downward (to the roadway). A combination wireway and bracket assembly for mounting fixtures was required to accomplish this distribution.

The original incandescent lighting system had operated from the existing 25-cycle power line. For the type and number of units in the new lighting system, however, 480-volt 60-cycle was required. This final problem of the installation was solved by the local utility company. Their primary 60-cycle lines were extended one and a half miles to supply the tunnel with the required system.

1. "Lighting Traffic Tunnels and Underpasses," official IES Technical Committee Report, ILLUMINATING ENGINEERING, Vol. LII, No. 6, p. 325 (June 1957).
2. Brass, J. R., Skootsky, H., and Trosper, G. A.: "A New Approach to Highway Tunnel Lighting," ILLUMINATING ENGINEERING, Vol. LII, No. 3, p. 137 (March 1957).
3. Haselsteiner, Karl: "Deas Island Tunnel," ILLUMINATING ENGINEERING, Vol. LV, No. 9, p. 467 (September 1960).
4. "Lighting for Mule Pass Tunnel," ILLUMINATING ENGINEERING, Vol. LV, No. 3, p. 144 (March 1960).
5. Brass, J. R., and Skootsky, H.: "Versatile Lighting System for Highway Tunnels," ILLUMINATING ENGINEERING, Vol. LV, No. 3, p. 147 (March 1960).

QUITE OBVIOUSLY a lighting plan for an area like Cobo Hall is a major illuminating engineering project. So successful were its final results that a run-down of the designers' approach, objectives and methods is of considerable interest to other illuminating engineers.

Considering the hall's enormous size and the many different uses to be made of it, the lighting objectives were ambitious. They represented especially "big thinking" at the time they were first proposed (1955) since the best recommendation for such halls then was an easy 30 footcandles. Objectives established from the beginning were:

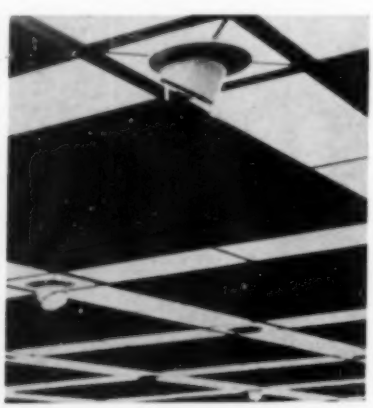
- A design to be both functional and esthetic.
- A minimum of 125 footcandles maintained.
- Recessed lighting system.
- Minimum direct glare.
- Flexibility of lighting levels.
- Ratio of highlighting to general lighting—5 to 1.
- Service floor outlets.
- Economical and practical lighting system to meet rigid budget limitations.

Numerous lighting designs were researched for the most effective application that would accomodate these objectives. The system selected is planned on 10-foot centers running both lengthwise and crosswise of the ceiling. Adjustable recessed spotlights are incorporated into the over-all ceiling pattern for highlighting.

One major objective was to control brightness within design limits. Research indicated that 1000 footlamberts average brightness at 45 degrees would be visually comfortable at a 30-foot mounting height. Calculations determined that three-lamp 40-watt recessed luminaires would produce 150 footcandles, the approved design level. Experiments with low-brightness glass diffusers at various distances from the lamps indicated that a distance of 4½ inches from lamp center to bottom of lens assured maximum effectiveness of the light source. A low-brightness glass diffuser which met design objectives was chosen for its permanence, ease of cleaning, hiding power and favorable static characteris-

This installation was engineered and designed by Giffels & Rossetti, Inc., Detroit, Mich., architects and engineers; F. L. Lantz, Senior Electrical Engineer. The installation won first prize in the Michigan Section and Great Lakes Regional IES Applied Lighting Competitions, and placed third in the National Competition in St. Louis, September 1961.

General lighting levels of 150 fc are available in three exhibit halls from system of three-lamp troffers mounted crosswise and lengthwise on 10-foot centers. 500-watt PAR-64 spots provide up to 1000 fc of highlighting.



Closeup of troffer system. Note brightness of glass door surrounding spot closely matches that of adjacent unit.

Diversified lighting effects for approximately 1½ million square feet of floor space . . . This was the vast undertaking for Detroit's new exhibition center . . . . .

COBO HALL

ties. Over-all depth of the system is 7½ inches.

Highlighting

At intersections of fluorescent luminaires, two-foot square incandescent spotlights were installed to provide highlighting and to form an integrated grid pattern. This fixture was designed to use the 500-watt PAR-64 narrow beam spotlight. Punch, compactness, adequate adjustability, and a 45-degree matte black louver for shielding are the principal attributes of the unit.

Surrounding the spotlight, to illuminate the glass in the door, are four 15-watt T12 fluorescent lamps in a square pattern. Lamps are located two inches nearer the glass to provide matching diffuser brightness with adjacent luminaires. Exhibits in the hall can be highlighted upwards of 1000 footcandles by using several units.

Illumination Levels

Measurements made after 2000 hours use of the installation were 160 footcandles. Maintained levels will average 150 fc. This is many times the level provided in other similar exhibition facilities.

In Hall D, luminous ceiling design includes 16,500-watt PAR-64 spotlights per bay, with 45-degree shielding and a 10-degree cone.

Visual comfort, moreover, is excellent. Average brightness curves of the diffuser-lens ranges from 770 footlamberts at 45 degrees to 170 footlamberts at 85 degrees. The concrete floor is 40 footlamberts, the ceiling 28 footlamberts. Columns and wall 19 feet above the floor were recorded as 25 and 35 respectively.

Experience in the first three halls resulted in further improvements in the design objectives for Hall D. Illumination here, from a luminous ceiling, is controlled for 150 and 75 footcandles. Brightnesses of the luminous ceiling and the surrounding surfaces were well below design objectives . Brightness measurements for the luminous ceiling show: at 45 degrees, 130 fL; at 55 degrees, 100 fL; at 65 degrees, 80 fL; at 75 degrees, 60 fL; and at 85 degrees, the brightness measured 15 footlamberts. Adjacent metal pan ceiling is 18 footlamberts; walls, 30; columns, 25; and floor, 38 fL.

In this design, 16 500-watt PAR-64 spotlights per bay, with 45-degree shielding and a 10-degree cone, are provided for highlighting.

The lighting systems are operated at 277 volts and remotely controlled. Continuity of lighting is guaranteed by feeders from independent power sources as well as battery operated emergency lights.

Flexibility

Since the Hall is used for a wide variety of purposes, flexibility of lighting effects and levels is an important attribute of the installation. As an example, for a recent ABC Bowling Tournament held at Cobo Hall, only one lamp of three-lamp troffers was lighted, producing tournament specifications of 60 footcandles for the alleys, and 30 fc for the spectator area. Many different lighting levels may be obtained to create the appropriate environment for trade shows, large meetings, dances.

If still more light is required to meet future revision of lighting requirements, the installation may easily be adapted to this also. Spare raceways are provided for additional fixtures should these be required during the life of the building.

RESTYLING

A Dining Area

LIGHTING for critical tasks, for decorative effect, to conceal structural deficiencies, to enlarge the space—these are the keys to the new look of this remodeled kitchen/dining area. Harnessing the many uses of light, designer Hazel Harbauer has restyled the kitchen and utility room of a 15-year old home to create the attractive modern area pictured on these pages.

First step in remodeling was the removal of existing walls between the old kitchen and the utility room and hall, creating a new 22- by 14-foot space. With the walls removed, visual separation of the kitchen/dining area from the living room was effected by the use of identical free form dividing lines in both ceiling and floor, with different ceiling and flooring materials used on each side of the line. A swirl plaster ceiling and white carpeting mark the beginning of the living room; a standard plaster ceiling and grey-white tile define the dining space.

Restyling for the new dining area was begun by the removal of a door on the wall at left, and reconstruction of the entire wall with white-painted brick. On the rear wall, an existing window was replaced with an eight-foot glass door to provide a view of the backyard patio and pool. Cornice lighting for both these newly constructed walls contributes to the definition of dining space. The cornice above the brick wall houses one 40-watt and one 30-watt deluxe warm white fluorescent lamp; two 40-watt deluxe warm white lamps illuminate the draperies covering the glass wall. Supplementing this wall lighting are seven ceiling recessed round frame louvered units housing 75-watt R30 lamps. Dimming controls for both ceiling and wall lighting and relamping of the ceiling units with blue, pink or yellow sources can provide

Remodeled Dining Area

With Light

the needed flexibility of lighting effects to accommodate social activities which vary from teenage gatherings to adult cocktail parties.

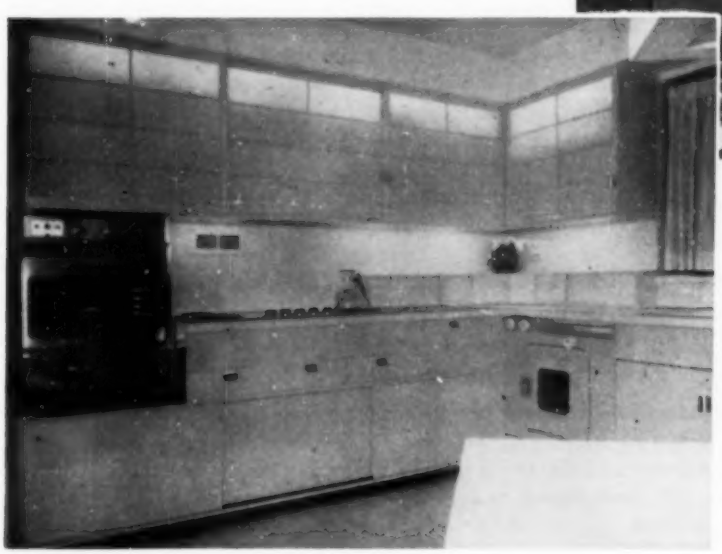
Separating the dining area from the adjoining kitchen is a peninsula snack bar and glass cupboard. Functional illumination for the white Formica counter top and decorative illumination to display the crystal housed in the cupboard are provided by six 20-watt deluxe warm white fluorescent lamps, shielded with white Fiberglas, on the underside of the cabinet, and two 40-watt and two 20-watt lamps at the top of the cupboard interior.

In the kitchen, under-cabinet fluorescent lighting supplies high level illumination at critical work areas. Two 40-watt and two 20-watt lamps provide levels of 35 footcandles at the range and 56 footcandles at the work counter. Two more 20-watt lamps light the top of the washer-dryer combination on an adjacent wall. Further increase in the general illumination level and attractive display of the specially designed white Fiberglas shoji cabinet doors are obtained from four 20-watt lamps positioned at the top interior of the cupboards which line the top of the oven-range wall. Functional lighting of 40 footcandles for the white porcelain sink is from a recessed unit housing a 75-watt R30 lamp.

A decorative trick, to conceal the furnace and ironer to the left of the range is the back-lighted shoji wall. Here, lighting from ceiling-mounted 40-watt fluorescent lamps simulates a daylight effect and visually enlarges the kitchen space.

This multiplicity of lighting effects, combined with carefully selected surfaces to assure visual comfort, has created a distinctive interior in this older home which compares favorably with that of its newer neighbors. The lighting design by Hazel Harbauer, electric living advisor, Toledo Edison Co., Toledo, Ohio, tied for fourth place in the national Applied Lighting Competition. The installation had previously won first prize in the Great Lakes Region and Northwestern Ohio Section.

▲ Snack Bar and Cupboard



◄ Kitchen Work Area

INSTALLATION AT INGBER, INC., H AND WESTMORELAND STS., PHILADELPHIA, PA.

Lighting Warehouse Bins

LIGHTING OBJECTIVE: To provide illumination for easy and rapid identification and selection of medium size boxes in an active warehouse.

GENERAL INFORMATION: The stock area shown above measures 68 feet long by 7 feet wide (between stacked boxes on shelves). The ceiling height is 16 feet. The boxes, which contain handbags manufactured by Ingber, Inc., are stacked from just above the floor (natural pine, 31 per cent reflectance) to a maximum height of 11 feet.

INSTALLATION: Sixteen single-lamp fluorescent units, Metalcraft Products Co., Inc., catalog No. C1-96-800, each equipped with one 96-inch T-12, 800-ma cool white rapid-start lamp, provide the illumination in this area. The luminaires are chain suspended 12 feet above the floor, in two continuous rows of eight each, five feet on centers.

After approximately 500 hours use the illumination was measured as 45 footcandles at floor level to 75 footcandles five feet above the floor.

Note: The unlighted fluorescent units shown above are part of the former lighting system in this relighted area. They are not part of the new system and have since been removed.

Lighting designed by Thomas P. Ferris, Philadelphia Electric Co., Philadelphia, Pa.

Lighting data submitted by Thomas P. Ferris and George T. Anderson, Jr., both of Philadelphia Electric Co., Philadelphia, Pa., as an illustration of good lighting practice and to aid in the design of similar installations.

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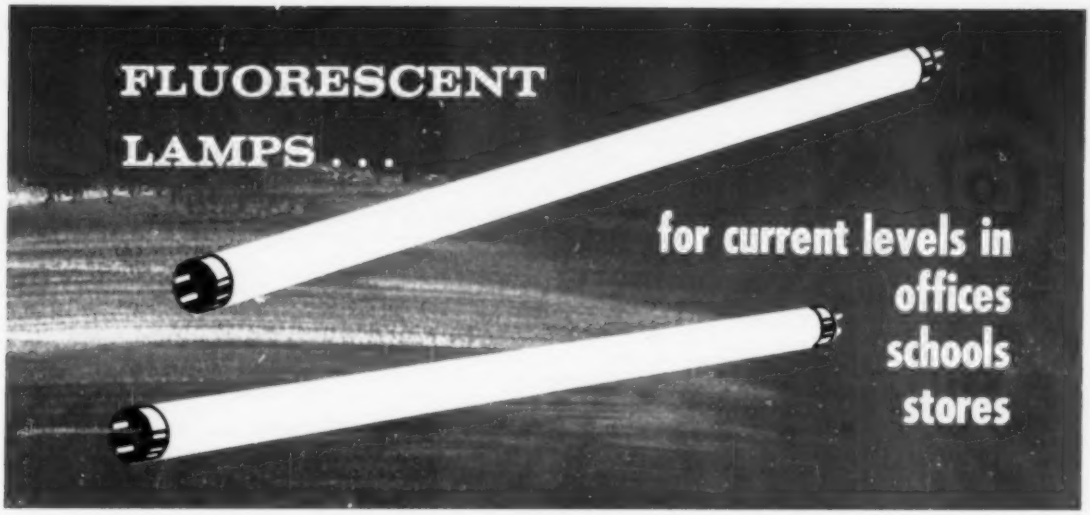


By R. N. EDWARDS, JR., and K. H. THOMPSON

Will only the high-output and extra high-output lamps deliver the higher levels now required in commercial applications? Can they be safely substituted for conventional lamps in all commercially available luminaires? How do they affect the "scissors curve?" This interesting study evaluates lighting requirements for offices, schools and stores for 425-, 800-, and 1500-ma lamps in typical commercial luminaires. Each application is considered with respect to comfort, economics, and ballast heat and noise, for a range of illumination levels. Analyses and limitations of each system are discussed.

In lighting to the new IES recommended levels, there is a natural inclination to specify either the high-output (800-ma) or the extra-high-output (1500-ma) fluorescent lamps in commercially available luminaires. Experience to date with industrial luminaires has shown these lamps to be economically sound and reliable sources. However, little is known concerning their performance in luminaires designed for office, school, and store applications. This paper intends to fill the void.

Typical luminaire types in typical areas were tested for actual performance. Table I lists and describes the luminaires considered in the study. For example, Type 2S is a recessed mounted two-foot by four-foot luminaire with four four-foot, 430-ma fluorescent lamps. Type 2B is a suspension mounted eight-foot luminaire with two eight-foot, 800-ma high output fluorescent lamps.

Typical areas chosen for study included: Office area, 50 feet by 100 feet, with a nine-foot ceiling. It was assumed that such a wide area would consist of large and small areas, with an average room index of D. Store area, 60 feet by 100 feet, with a 12-foot ceiling (Room Index C). School area, a classroom 25 feet by 30 feet, with a nine-foot ceiling (Room Index D).

A paper presented at the National Technical Conference of the Illuminating Engineering Society, September 24-29, 1961, St. Louis, Mo. Authors: Westinghouse Lighting Division, Cleveland, Ohio.

Photometric Test Results

The purpose of this test was to determine how luminaire efficiency is affected if luminaires designed for 430-ma lamps are operated with 800-ma and 1500-ma lamps. To keep the amount of trapped light constant, only lamps of T12 design were used. Table II lists the actual test efficiencies as obtained in the photometric laboratory. Fig. 1 is a plot of luminaire efficiency *vs* fluorescent lamp milliampere current. As shown, both suspension mounted luminaires and the bare lamp luminaire have approximately the same efficiency regardless of lamp used. This occurred because the luminaires are completely ventilating and allow the heat developed

to dissipate, as might be expected for all similarly designed luminaires.

Once the luminaire is designed to a shape which inhibits the free circulation of air around the lamps, luminaire efficiency decreases as lamp current increases. Two recessed and one surface mounted types of luminaire were tested with both 45-degree plastic louver and plastic control lens. Control lenses are known by their inherent characteristic to redirect light from the direct-glare zone into

Table I—Commercial Fluorescent Luminaires for Application in School, Office, and Store Areas

APPLICATION	SYMBOL	DESCRIPTION	SKETCH
Office 50′ width 100′ length 9′ ceiling	1	Recessed mounted 2′ x 4′ luminaire with four, four-foot fluorescent lamps and plastic 45° x 45° louver. Depth 5″ over-all.	
	2	Recessed mounted 2′ x 4′ luminaire with four, four-foot fluorescent lamps and plastic control lens. Depth 5″ over-all.	
Classroom 25′ width 30′ length 9′ ceiling	3	Suspension mounted (12″ hanger) luminaire with two, four-foot fluorescent lamps and 35° x 45° metal louver. Width 13″, depth 5″ over-all.	
	4	Suspension mounted (12″ hanger) luminaire with two, four-foot fluorescent lamps and plastic control lens in place of louver blades beneath each lamp. Width 13″, depth 5″ over-all.	
Office 50′ width 100′ length 9′ ceiling	5	Recessed mounted 1′ x 4′ luminaire with two, four-foot fluorescent lamps and plastic 45° x 45° louver. Depth 5″ over-all.	
	6	Recessed mounted 1′ x 4′ luminaire with two, four-foot fluorescent lamps and plastic control lens. Depth 5″ over-all.	
Office 50′ width 100′ length 9′ ceiling	7	Surface mounted luminaire with two, four-foot fluorescent lamps and plastic 45° x 45° louver. Depth 3⅛″ over-all, width 16¾″.	
	8	Surface mounted luminaire with two, four-foot fluorescent lamps and plastic control lens. Depth 3⅛″ over-all, width 16¾″.	
Store 60′ width 100′ length 12′ ceiling	9	Surface-mounted luminaire with two, four-foot fluorescent lamps having no shielding. Width 4⅝″, depth 4″ over-all.	
All	2-	Denotes eight-foot lamps in eight-foot luminaire only.	All
All Above	A	4-foot 430-ma T12 fluorescent lamp rated 2800 lumens. (8-foot lamp is 425 ma T12 rated 5600 lumens.)	
All Above	B	4-foot 800-ma T12 fluorescent lamp rated 3850 lumens. (8-foot lamp is 800 ma T12 rated 9000 lumens.)	
All Above	C	4-foot 1500-ma T12 fluorescent lamp rated 6900 lumens. (8-foot lamp is 1500 ma T12 rated 15,000 lumens.)	

Table II—Summary of Test Results

(For curve plot, see Fig. 1; for luminaire description, Table I.)

LUMINAIRE SYMBOL	LAMP SYMBOL A	B	C
	LUMINAIRE EFFICIENCY (PER CENT)		
1	54.9	50.0	47.2
2	61.9	56.0	47.8*
3	82.9	81.5	81.2
4	82.2	81.5	81.0
5	52.7	47.1	41.5
6	59.1	53.6	44.5
7	67.4	63.6	51.1
8	58.4	55.8	46.7
9	93.4	91.3	90.0

*Note: Luminaire 2C efficiency with ballast remotely mounted is 49.4 per cent.

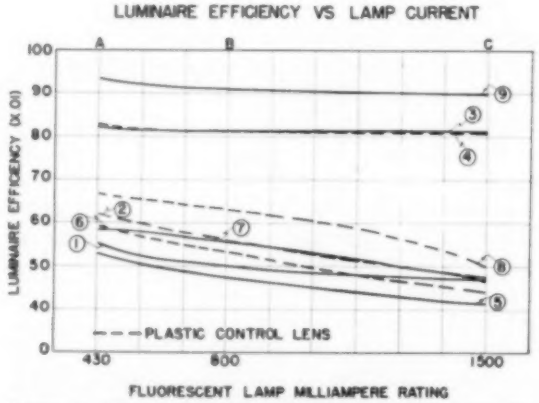


Figure 1. Plot of luminaire efficiency vs lamp current for the test data listed in Table I and luminaires as described in Table I.

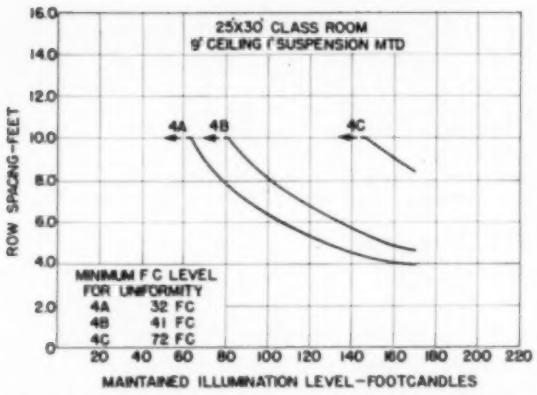


Figure 2. Curves show the relationship between spacing and illumination level for types 4A, 4B and 4C in a 25- by 30-foot classroom with nine-foot ceiling and one-foot suspension. Solid lines are for continuous row mounting, dotted lines for individual mounting; table of minimum recommended footcandles for individual mounting. Work plane considered to be 30 inches.

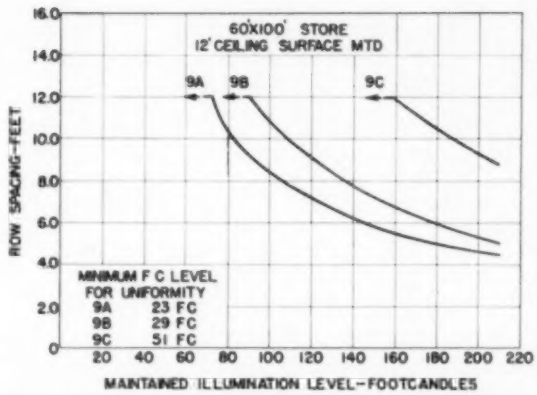


Figure 3. Curves show relationship between spacing and illumination level for types 9A, 9B and 9C surface mounted in a 60- by 100-foot store with 12-foot ceiling. Solid lines are for continuous row mounting, dotted lines for individual mounting; table of minimum recommended footcandles for individual mounting. Work plane considered to be 30 inches.

the 0- to 45-degree zone and still provide the luminaire with high efficiency—higher, for example, than that provided by the 45-degree plastic louver. The test data show emphatically that as lamp current increases, the efficiency of the luminaire with plastic control lens approaches that of the luminaire with 45-degree plastic louver. Luminaires 2C and 1C have almost the same efficiency, while at 430-ma the efficiencies are in a ratio of 1.00 to 1.13 (see 2A and 1A).

At this point in the test procedure, luminaire 2C was tested with the ballast for 1500-ma lamps located remotely from the luminaire. An increase in luminaire efficiency from 47.8 per cent to 49.4 per cent was obtained, an increase of 3.3 per cent.

Only luminaires of design 3C and 4C had ballast compartments with sufficient depth to contain the 1500-ma ballasts, so, special enclosures, from steel similar to that used in the housing, were built for the rest of the luminaires. Because the results from the remotely mounted ballast indicated that ballast heat had little effect on luminaire efficiency, it was felt this method of special ballast enclosures could be justified.

Application Considerations

Row Spacing vs Footcandles

Careful attention must always be given to spacing of luminaires to assure uniformity of illumination; however, this is becoming more of a limitation than a guide in layout design with the advent of lower and lower ceilings, and, hence, lower mounting heights. As the total lumens available from a luminaire increases, the number of luminaires required for a given footcandle level will decrease and, of course, the row spacing will increase. This relationship between spacing and illumination level for 425-, 800-, and 1500-ma lamps is shown in Figs. 2, 3, 4, and 5.

Each set of curves illustrates with a solid line the decrease in spacing with increased illumination when the luminaires are mounted in continuous rows. At a given point, depending upon the lamp used, it is impossible to maintain uniformity with continuous rows. Therefore, rows of individually mounted luminaires are used, and spacing between rows remains constant as shown by the dotted line.

Even with individual mounting, there is a limit to the minimum footcandle level possible, since proper uniformity must be maintained. This minimum footcandle level is indicated for each luminaire rather than by extending the dotted portion of each curve to the limit.

Certain general limitations are readily observed for each application shown, *e.g.*, office, school and store. The minimum footcandle level for luminaires with 1500-ma lamps is much higher than that for either 800-ma or 425-ma, and is more than twice their value in some cases. This restricts the use of 1500-ma units in continuous row mounting to higher levels of illumination. For instance, in Fig. 2, the classroom with type 4C luminaires in continuous rows should not be used for applications of less than 145 footcandles, and 72 footcandles when individually mounted. For the office (Fig. 5), this unit should not be used for less than 230 footcandles in continuous rows, which certainly restricts its application under the present recommended IES levels. Individual mounting of the same luminaires will make a more practical range of illumina-

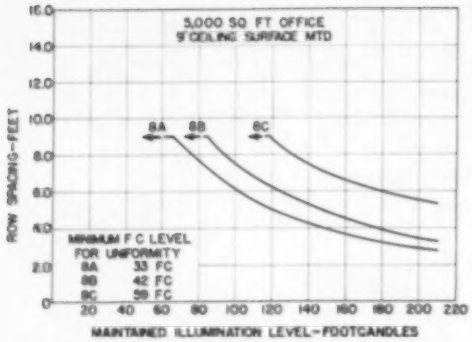


Figure 4. Curves show relationship between spacing and illumination level for types 8A, 8B and 8C surface mounted in a 5000-square-foot office with nine-foot ceiling. Solid lines are for continuous row mounting, dotted lines for individual mounting; table of minimum recommended footcandles for individual mounting. Work plane considered to be 30 inches.

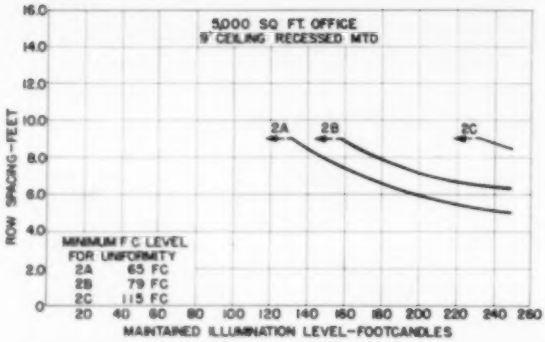


Figure 5. Curves show relationship between spacing and illumination level for types 2A, 2B and 2C recessed in a 5000-square-foot office with nine-foot ceiling. Solid lines are for continuous row mounting, dotted lines for individual mounting; table of minimum recommended footcandles for individual mounting. Work plane considered to be 30 inches.

tion levels possible; however, there is also a lower limit to this arrangement.

Although all of the luminaires have limitations when used both in continuous rows and individually mounted, the 1500-ma-lamp luminaire is the most restrictive. This may not be so serious as a first impression would indicate because the trend in lighting is toward higher levels of illumination. In fact, the time will come when illumination levels far in excess of present recommendations become so common as to eliminate this apparent limitation regarding 1500-ma-lamp luminaires. Of course, there are limitations on 425-ma-lamp luminaires at high footcandle levels when close spacing becomes objectionable from an appearance standpoint.

Average Brightness

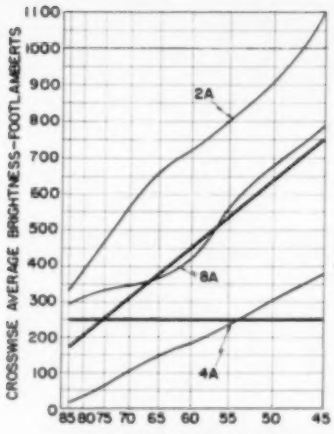
One important consideration for comfortable lighting is average brightness in the direct glare zone. A criterion for acceptable luminaire average brightness is commonly referred to as the "scissors curve."[1, 2] The "scissors curve" is represented by heavy black lines intersecting at 75 degrees and 250 footlamberts in Figs. 6 and 7. Luminaires meet this criterion if their average brightness distribution falls entirely below any line, drawn through the intersection of the limiting curves, and lies between them.

Crosswise average brightness curves are shown in Fig. 6 for the recessed, surface mounted, and suspension mounted luminaires considered in this study. The same information is shown for lengthwise average brightness in Fig. 7. Examination of these curves reveals that none of the luminaires considered meets the scissors curve limitations in both directions with 430-ma lamps. However, the general purpose luminaire, type 4A, does conform in the crosswise direction. This means it should be mounted perpendicular to the predominant line of sight to gain maximum benefit from its low crosswise brightness.

Although the surface mounted luminaire does not meet the scissors curve limitations, it has acceptable average brightness in the lengthwise direction up to 75 degrees. The recessed luminaire, on the other hand, has average brightness values that are much higher than the limiting values of the direct glare zone—in both directions.

A table of conversion factors shown on both drawings may be used to convert the plotted average brightness data for comparison of luminaires with 800-ma or 1500-ma lamps instead of 425-ma lamps. Since the surface mounted and recessed luminaires have average brightness values which are too high with 430-ma lamps, there is certainly no chance that they would meet the scissors curve with 800-ma or 1500-ma lamps. This is true because each value along curves designated 2A and 8A must be multiplied by, for example, 1.38 and 2.43 (from table) to convert to luminaires with 800-ma and 1500-ma lamps, respectively. The general purpose suspension mounted luminaire will, however, fall within the limitations in the crosswise direction when used with 800-ma lamps—an important consideration when comfort is of primary concern and the ue of 800-ma lamps s contemplated.

A serious limitation to the use of conventional type luminaires with high-output and extra-high-output lamps is that of excessive average brightness in the direct-glare zone. Although some luminaires may have better brightness characteristics than those shown, it appears that 1500-ma lamps will not render acceptable brightness levels from the standard types of commercial luminaires considered.

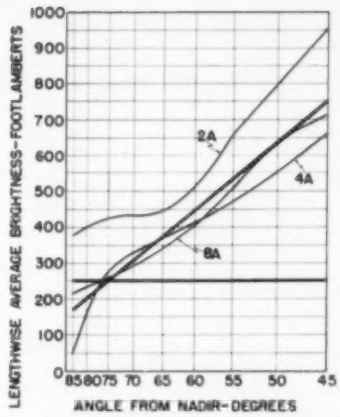


CURRENT (MA)	4-FOOT LAMP LUMENS	AVG BR CONV FACTOR	8-FOOT LAMP LUMENS	AVG BR CONV FACTOR
430	2,800	1.00	5,600[1]	1.00
800	3,850	1.38	9,000	1.61
1500	6,900	2.43	15,000	2.68

[1] 8' SLIMLINE LAMP IS 425 MA

◀ **Figure 6. Crosswise average brightness distribution for luminaire types 2A, 4A and 8A in the direct glare zone. The scissors curve is represented by straight lines intersecting at 250 fL and 75 degrees. A table of conversion factors for comparison of 800- and 1500-ma lamp luminaires is also shown.**

Figure 7. Lengthwise average ▶ brightness distribution for luminaire types 2A, 4A and 8A in the direct glare zone. The scissors curve is represented by straight lines intersecting at 250 fL and 75 degrees. A table of conversion factors for comparison of 800- and 1500-ma lamp luminaires is also shown.



CURRENT (MA)	4-FOOT LAMP LUMENS	AVG BR CONV FACTOR	8-FOOT LAMP LUMENS	AVG BR CONV FACTOR
430	2,800	1.00	5,600[1]	1.00
800	3,850	1.38	9,000	1.61
1500	6,900	2.43	15,000	2.68

[1] 8' SLIMLINE LAMP IS 425 MA

Economic Analysis

Economic analysis is always difficult because the choice of circumstances cannot encompass the field of application considered. Table III presents data for the use of four-foot fluorescent lamps, chosen because there are areas today where eight-foot lamps are absolutely not considered. For instance, in buildings having nine-foot ceilings, the use of eight-foot lamps suggests clumsiness; however, experienced maintenance personnel can handle them with ease. For this reason, Table IV is presented with essentially the same designs of luminaire, except with eight-foot lamps. Recessed luminaires, one by four feet and two by four feet (compared to one by eight feet and two by eight feet) have never been popular and, for this reason, have been excluded from Table IV. It was desirable to present reasonable data in two ways: (a) reasonable in that the number of luminaires involved fit the area in a symmetrical manner, and (b) present the results so that hidden differences are exposed. Both tables, therefore, show results in cost per footcandle—initial cost plus annual cost. The bar diagrams of both tables indicate no set patterns has developed.

School Area

From Table IV, the results are obvious: the higher the lamp loading, the more economical the cost per footcandle becomes. The minimum number of eight-foot luminaires possible is six, thereby limiting the choice for a design level of 70 footcandles between 425-ma and 800-ma lamps.

Table III shows quite a difference in results. The 430-ma-lamp luminaire cost has overtaken the 800-ma luminaire cost and moved close to the 1500-ma luminaire cost. The primary reason—four-foot high-output and extra-high-output lamps do not have one-half lumen output of similar eight-foot lamps.

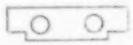
Store Area

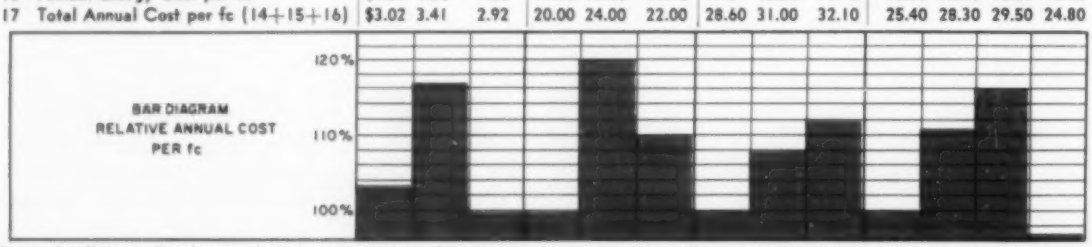
The bar diagrams for stores are quite different from those for the classroom. The reason may be found by analyzing the three components of annual cost: fixed cost, maintenance cost, and energy cost. The following method can be used to analyze the data. Eliminate the least significant variable. Determine from the remaining two which one is predominant. Uusually, the predominant cost will favor one type of luminaire and make it more economical. In Table III, the predominant cost, energy, does not favor either of the higher loaded lamps, thus the economic analysis shows the 430-ma-lamp luminaire to be least expensive. In Table IV, the higher loaded lamps become slightly more economical because of increased lumen outputs.

Office Area

Table III definitely shows the economic choice of either surface or recessed mounted equipment to be the 430-ma-lamp luminaire. Again, the energy cost is controlling the results, since the luminaire efficiencies with higher loaded lamps have been reduced. It is obvious that the controlling element is the minimum maintained lumen output of the luminaire, not energy cost. Table IV presents results similar to those in the above paragraph, for stores.

Table III—Cost Analysis for Typical School, Store, and Office Areas Utilizing Four-Foot Fluorescent Lamps

		CLASSROOM			STORE			OFFICE						
		25′ × 30′ × 9′			60′ × 100′ × 12′			50′ × 100′ × 9′						
	LUMINAIRE													
		4A	4B	4C	9A	9B	9C	8A	8B	8C	2A	2B	2C	XY
1	Design Illumination Level		70			150				200				
2	Rated Initial Lumens	5600	7700	13800	5600	7700	13800	5600	7700	13800	11200	15400	27600	30000
3	Lamp Life—Group Replacement at 60% Average Life		6500			7200				6900				
4	Luminaire Watts	96	147	255	96	147	255	96	147	255	192	294	510	510
5	Coefficient of Utilization	.59	.58	.58	.78	.76	.75	.59	.56	.45	.58	.54	.45	.58
6	Maintenance Factor	.81	.76	.75	.80	.75	.74	.76	.72	.70	.76	.72	.70	.70
7	Number of Luminaires	24	18	9	250	200	125	396	324	238	204	168	120	88
8	Actual fc Min. Maintained	85	81	72	146	147	160	198	201	207	202	204	210	218
9	Annual Burning Hours		2200			3740				2860				
10	Luminaire Cost (each)	$23	34	44	10	18	22	30	38	44	57	68	77	141
11	Wiring and Installation (each)	$10	12	19	9	11	16	11	13	18	13	17	30	30
12	Total Initial Cost per fc	$9.90	11.10	8.80	36	45	35	86	86	79	75	77	70	75
13	Annual Cleaning Cost	$33	24	12	360	288	187	986	807	593	677	558	398	292
14	Annual Fixed Charges per fc	$1.40	1.53	1.18	4.90	5.90	4.40	12.30	12.30	10.70	10.60	10.50	9.20	10.40
15	Annual Maintenance Cost per fc	$.55	.58	.47	4.10	4.60	4.10	6.50	6.50	6.30	4.90	5.30	5.30	3.80
16	Annual Energy Cost per fc	$1.07	1.30	1.26	11.10	13.50	13.40	9.90	12.20	15.10	10.00	12.50	15.00	10.60
17	Total Annual Cost per fc (14+15+16)	$3.02	3.41	2.92	20.00	24.00	22.00	28.60	31.00	32.10	25.40	28.30	29.50	24.80



Data: Coefficient of utilization based on 75/40/20 reflectances minimum in service. Energy rate $.018/kw. hr. Lamp cost each, list less 30 per cent: (A) $.91; (B) $1.89; (C) $3.64. Fixed charges usually 15 per cent of total initial cost less lamps. Luminaire cleaning at lamp replacement time plus one interim cleaning. Assumed lamp burning hours per start: Classroom, 9; Store, 12; Office, 11.

Special Consideration

Even with present limitations, the 1500-ma lamp has the most promising future. As the IERI continues through research to gather information concerning the requirements of human vision, still higher illumination levels will no doubt be recommended, so that seeing occurs not only at maximum efficiency, but also with maximum ease. Luminaires designed to provide these levels are not commercially available at present. Such a luminaire is noted as *XY* in Table III. For the purposes of this analysis, *XY* will have four 1500-ma lamps, four feet in length, having one-half the lumen output of present day eight-foot 1500-ma lamps. It will be designed to dissipate heat to the extent that luminaire efficiency returns to that of luminaire 2A. For brightness control, a parabolic louver[4] can be employed. The cost of this luminaire can be almost twice that of the present day 2C luminaire. The annual cost per footcandle will be slightly less than the present day 2A luminaire. Specifically, luminaire *XY* will give the lighting layout designer a superior tool for minimum maintained in-service illumination levels to 450 footcandles before the ceiling becomes one-third filled with luminaires. Thus, the possibilities of integrating lighting, heating, cooling, and acoustic methods become much more practical.[5] In fact, the economic analysis data here alone establish the need for environmental integration of all human comfort elements.

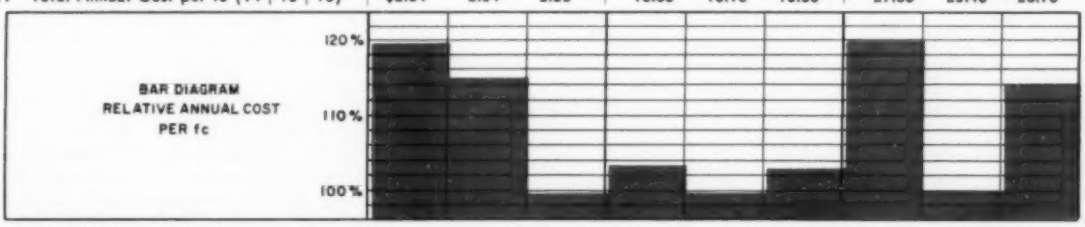
Ballast Noise and Heat

Noise attributable to fluorescent ballasts will depend upon the construction of the luminaire, type of mounting, room acoustics, and number of luminaires, to name a few. Ballast sound rating is presently determined in open air, thereby avoiding differences caused by various luminaire designs. It will be assumed for this discussion that both room acoustics and luminaire design are properly correlated to have no effect on ballast noise and. hence, may be eliminated from consideration.

Ballasts with sound ratings *D* or better for use in classrooms (32-42 db), *E* or better for use in business offices (43-48 db), and *F* or better for use in stores (49 db +), will be generally satisfactory.

Table IV—Cost Analysis for Typical School, Store, and Office Areas Utilizing Eight-Foot Fluorescent Lamps

	LUMINAIRE	CLASSROOM 25′ × 30′ × 9′			STORE 60′ × 100′ × 12′			OFFICE 50′ × 100′ × 9′		
		2-4A	2-4B	2-4C	2-9A	2-9B	2-9C	2-8A	2-8B	2-8C
1	Design Illumination Level		70			150			200	
2	Rated Initial Lumens	11200	18000	30000	11200	18000	30000	11200	18000	30000
3	Lamp Life—Group Replacement at 60% Average Life		6500			7200			6900	
4	Luminaire Watts	174	255	500	174	255	500	174	255	500
5	Coefficient of Utilization	.59	.58	.58	.78	.76	.75	.59	.56	.45
6	Maintenance Factor	.81	.76	.75	.80	.75	.74	.76	.72	.70
7	Number of Luminaires	9	6	6	126	91	56	198	138	108
8	Actual fc Min. Maintained	64	60	105	148	154	154	198	200	203
9	Annual Burning Hours		2200			3740			2860	
10	Luminaire Cost (each)	$41	48	53	15	25	33	60	66	72
11	Wiring and Installation (each)	$18	24	34	17	24	31	20	24	34
12	Total Initial Cost per fc	$8.90	7.80	5.50	31	33	27	84	66	61
13	Annual Cleaning Cost	$22	16	16	393	284	175	974	679	531
14	Annual Fixed Charges per fc	$1.13	1.07	.74	4.10	4.40	3.50	12.00	9.30	8.50
15	Annual Maintenance Cost per fc	$.55	.45	.32	4.50	3.60	2.80	6.60	5.00	4.50
16	Annual Energy Cost per fc	$.97	1.02	1.13	10.00	10.10	12.20	9.00	9.10	13.70
17	Total Annual Cost per fc (14+15+16)	$2.64	2.54	2.20	18.60	18.10	18.50	27.60	23.40	26.70



Data: Coefficient of utilization based on 75/40/20 reflectances minimum in service. Energy rate $.018/kw hr. Lamp cost each, list less 30 per cent: (A) $2.10; (B) $2.80; (C) $4.38. Fixed charges usually 15 per cent total initial cost less lamps. Luminaire cleaning at lamp replacement time plus one interim cleaning. Assumed lamp burning hours per start: Classroom, 9; Store, 12; Office, 11.

Therefore, since the standard two-lamp 425-ma series slimline ballasts used are sound rated *C*, 430-ma rapid start rated *B*, 800-ma rated *D*, and 1500-ma rated *E*, their suitability for typical applications is easily determined. The 425-, 430-, and 800-ma-lamp luminaires may be used in any of the applications considered above, and the 1500-ma unit may be used in stores.

The use of extra-high-output units in classrooms and offices may be satisfactory if luminaire design, mounting, and room acoustics are favorable, and no exceptionally quiet periods exist. It must be said that excessive ballast noise will not preclude the use of extra-high-output luminaires in the applications considered, but it will be greatly limited.

The use of higher loaded lamps certainly involves consideration of ballast operating temperature limitations. All luminaires with 425- or 430-ma lamps mentioned in this paper are listed with the Underwriters' Laboratories, Inc., as are types 4 and 9 for use with 800-ma lamps. Possibly if the suspension mounted type 4 luminaire were tested, listing for use with 1500-ma lamps could be obtained, because industrial units are presently listed and have approximately the same conditions. High- and extra-high-output lamps do have serious ballast overheating problems which preclude their use in surface mounted and recessed luminaires.

Summary

This paper has considered the application of high-output and extra-high-output fluorescent lamps in commercial luminaires designed for 425- and 430-ma lamps with respect to row spacing, average brightness, economics, and ballast limitations of heat and noise.

Generally, the 425- and 430-ma lamps are still the most practicable for the current range of recommended illumination levels. The specific advantage of higher loaded lamps, at higher footcandle levels, is a less cluttered ceiling appearance because of the number of luminaires required per footcandle.

In certain instances, an economic advantage is obtained for 800- or 1500-ma lamps over 425- and 430-ma lamps; however, economy should never be the sole criterion for choosing the luminaire. In

most cases, the use of heigher loaded lamps imposes a substantial increase in luminaire average brightness, compounding an already marginal condition. Generally, unless shielding medias such as described in a previous paper[4] are employed, excessive luminaire average brightness will occur when the higher loaded lamps are employed in conventional luminaires.

In the present state of the art, 1500-ma ballasts are both too noisy and too large for unlimited application in existing commercial luminaires. One foreseeable helpmate is operation at higher frequencies to reduce the over-all physical size.

Although a limited number of commercial luminaires utilizing extra-high-output lamps are available at present, the 1500-ma lamp seems to be destined for use with the integration of lighting, air conditioning, and acoustical elements. This is, perhaps, as it should be.

Acknowledgements

Special thanks are extended to the many persons who offered opinions and suggestions, in particular, R. A. Peterson, and J. B. Arens of the Photometric Laboratory.

References

1. *IES Lighting Handbook*, Third Edition, p. 11-6 (Fig. 11-4), published by Illuminating Engineering Society, New York, N. Y. 1959.
2. Crouch, C. L.: "New Levels and Scissors Curve Highlight Revised Office Practice," ILLUMINATING ENGINEERING, Vol. LV, p. 345 (June 1960).
3. Edwards, R. N., Jr.: "Maintenance Factors for Interior Lighting," ILLUMINATING ENGINEERING, Vol. LVI, p. 355 (May 1961).
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5. Fisher, W. S. and Flynn, J. E.: "Integrated Lighting—Air Conditioning Systems," ILLUMINATING ENGINEERING, Vol. LIV, p. 615 (October 1959).

DISCUSSION

R. D. BRADLEY:* In comparing the photometric performance of luminaires, I wish the authors had given more details pertaining to the ceiling brightnesses created by the lumens in the 90–180 degree zone, particularly for the higher loaded lamps. While they make reference to the "scissors curve," they fail to bring in the point that there is a maximum-to-average ratio of brightnesses required; I do not note any comments regarding this method of brightness application in the text.

As we use the higher loaded brighter light sources, we must be very conscious of reflected glare. I realize that the analyzation of reflected glare is still in its infancy. However, it must be recognized as it is easily possible to create very bad seeing conditions even though the proper number of footcandles may be provided and evenly distributed. The maintenance factors used should be based upon terminal maintenance in time and space as prescribed by the IES Testing Procedures Committee.

Also, I question their statement that ballast sound rating is presently determined in open air. To the best of my knowledge, this is not true with one of the larger manufacturers of ballasts, in that all ballasts are sound rated on a simulated fixture. This fixture is used for all tests so that the resonance and amplification effects will remain constant. Also, I do not believe the best practice would indicate that ballasts be sound rated in open air. Sound level evaluation for fixtures is still in a very controversial state; one leading ballast manufacturer, however, has devoted considerable effort and written several papers on the subject. These works have been in the right direction.

In making tabulations of costs, etc., for commercial analyzation, I personally prefer the Barr-Amick method, and in view of the need for consistency in this area, would suggest that this method be standard procedure. I am somewhat surprised at the annual cleaning cost figure shown for some of the fixtures. Can the authors comment on how they arrived at these figures? The difference between $22 for a 2-4A fixture in a classroom compared to $974 for 2-8A fixture in an office should have some explanation. The total annual cost for fixture 2-4A as compared to 2-8A in about a ten to one ratio does not seem to be consistent with similar work I have been doing. This ratio seems too large. It is possible that this difference may be due to the authors' method of calculation.

JOHN J. NEIDHART:* This paper should be very helpful to the lighting designed in developing an approach to the problem of selecting the best luminaires and lamp loading for a given application. The designer should be cautioned, however, against drawing any conclusions from this paper regarding the feasibility of 800-ma and 1500-ma luminaires in commercial areas. The authors state that all of their data are based upon luminaires designed for 430-ma lamps and indicating no experience with 1500-ma equipment. However, UL approved commercial equipment for 1500-ma lamps have long been available and proven satisfactory in commercial use. Furthermore, such equipment is not limited to suspended, direct-indirect units, as single and twin aluminum troffers for 1500-ma lamps are available and widely used.

Our own cost analyses have shown these 1500-ma installations to be not only practical but more economical than comparable installations employing either 430- or 800-ma lamps. These installations have also proven that ballast noise is definitely not a problem in most commercial areas, since the ambient noise level of a store or office easily masks the ballast noise. In my office, there are 150 footcandles from an installation of direct-indirect lumainaires equipped with 1500-ma lamps, and I have never been conscious of ballast hum even when working in the office at night or on weekends when the ambient noise level is low. Two-lamp ballasts for eight-foot 1500-ma lamps have been available with a "D" sound rating since early 1959, and 800-ma ballasts for eight-foot lamps have carried a "C" sound rating for three years now. Why, then, do the authors use a "D" rating for 800-ma ballasts and an "E" rating for 1500-ma, and on this basis conclude that the 1500-ma units can be used only in stores?

I agree with the authors in their use of the "scissors curve" in assessing the relative comfort of the various types of luminaires and lampings. This is the proper method and the only approved IES system. Here again, however, the authors' unfortunate selection of equipment is misleading in

*Day-Brite Lighting, Inc., St. Louis, Mo.

*The Miller Company, Meriden, Conn.

that it seems to indicate that very few luminaires, even when equipped with 430-ma lamps, can satisfy the scissors curve. Such is not the case; there are many suspended, surface-mounted, and recessed luminaires whose crosswise and lengthwise average brightness distributions easily fall below the limiting lines of the scissors curve when equipped with 430-ma lamps, and in some cases even when equipped with 800-map lamps. In fact, I could show a currently available troffer which fully complies with the scissors curve limitations when equipped with 1500-ma T-12 lamps. It could be further shown that an installation of these 1500-ma troffers would be more economical than a comparable installation of conventional 430-ma troffers.

On the basis many successful installations of 1500-ma equipment in commercial areas, I must strongly disagree with the authors' conclusions that "in the present state of the art, 1500-ma ballasts are both too noisy and too large for unlimited application in existing commercial luminaires." I must also disagree with their statement that "the 1500-ma lamp seems to be destined for use with the integration of lighting, air-conditioning, and acoustical elements." It is undoubtedly true that it will be used in such equipment, but it most certainly will not be and is not at present limited to such usage. The 1500-ma lamp is not just a lamp for the future as far as commercial lighting is concerned; it is a source that is already in wide use today.

B. F. JONES:* The authors are to be commended for pointing out some of the pitfalls to be encountered in the use of 800- and 1500-ma lamps in commercial applications, and for the data they have presented showing the losses to be expected when the higher output lamps are utilized in recessed and ceiling mounted luminaires, without proper regard for the ventilation necessary to the proper operation of these lamps.

It is my feeling, however, they may have reached some unwarranted conclusions from their tests. Specifically, I feel a reader might be misled by their statements, and assume that the 800-ma, and in particular the 1500-ma lamp, cannot be successfully used in commercial installations. Since we have many highly successful installations of these lamps in offices, stores, and schools, I feel that the situation is a bit overdrawn.

From the standpoint of the 800-ma lamp, my company has, for the past six years, made a luminaire which we feel has outstanding performance in schools and offices. This unit has been installed extensively in California schools, where it has been used to provide levels upward from 30 footcandles, with excellent uniformity. It meets all present or proposed school lighting codes as to quality, including, incidentally, the much-discussed scissors curve.

I am much surprised to note that the 1500-ma lamp cannot be used to provide uniform lighting at less than 72 footcandles maintained, even when individual units are used. Of course, I recognize that the authors are working with the specific—and, largely, not particularly applicable—units described in the paper. But it is just such information that tends to discourage people from using new approaches, so I should like to note that the 1500-ma lamp is currently being used to illuminate classrooms to a maintained level of 55 to 60 footcandles, with a ceiling uniformity not exceeding four to one, and a uniformity of illumination which varies less than 15 per cent from average, from wall to wall. One of these installations eventually will be profiled in ILLUMINATING ENGINEERING since it was a second place winner in the South Pacific Coast Regional Applied Lighting Competition. Installations of this type may utilize only four luminaires for a 30- by 30-foot classroom, not the minimum of six stated in the paper. Again, the luminaire meets all the codes, including the scissors curve.

Eight-hundred and 1500-milliampere ballasts do tend to be large, and they can be quite noisy. It is unfair to the ingenuity of the designer, however, to suggest that these characteristics will prevent their being used commercially—or at best in an integrated approach. Ballasts can be remoted in other places than an integrated ceiling, and are being so remoted every day. Luminaire design itself can go far to allow the ballasts to remain in the luminaire without being excessively noisy. Also, it should be noted that not only the noise rating of a ballast, but also the number of ballasts within the area, determines the noise level. Since with the higher current units, fewer are required to provide a given level, there is a mitigating factor in favor of the higher-current units. Finally, in the absence of a standard, it is not safe to assume that one manufacturer's "D"-rated ballast makes the same racket as another manufacturer's "D" unit. We have always found that, at least one major manufacturer, at any one time, makes a ballast quiet enough for use in practically any office or school application. Yes, we have had noise complaints,—but we've had those from "A"-rated ballasts, too! To illustrate the performance possible from a thoughtful combination of luminaire design and appropriate ballast, we were once requested to remove the ballast cover from a 1500-ma unit in an unoccupied classroom to prove to an engineer that we hadn't remoted the ballasts.

The point I wish to reiterate, is that it is not wise to indicate that any approach is impossible. I have too much respect for the ability and ingenuity of the designers of lighting equipment in this industry to suggest they might not be able to meet such a challenge. In the case of the 800-plus-ma lamps, 80,000-plus luminaire sales by only one manufacturer show that it can be done successfully.

R. N. EDWARDS, JR., and K. H. THOMPSON:* To Mr. Bradley: Ceiling brightness from suspension-mounted direct-indirect fluorescent luminaires is not easily calculated. Photometric curves present the luminaire as a point source of light. However, when calculating ceiling brightness, the luminaire is no longer a point source, nor a linear source, nor even a surface source of uniform distribution. The method used by the authors is as follows. For example, if a luminaire with two eight-foot 1500-ma lamps and 40 per cent efficiency in the 90- to 180-degree zone is considered with six-inch suspension from a ceiling of 80 per cent reflectance, the average ceiling brightness in an area three feet by eight feet will be less than $2 \times 15{,}000 \times .4 \times .8 \div 24$, or 400 footlamberts.

IES office lighting practice states: (1) that the preferable maximum brightness of a luminaire in the 45- to 85-degree direct-glare zone should be less than three times the respective average value at that angle, and in no case should exceed five times the value; (2) that the maximum brightness at a given angle should not exceed three times the limits of the scissors curve which is, for example, 750 footlamberts at 75 degrees and 2250 footlamberts at 45 degrees. All the luminaires referred to in Tables III and IV for school and office meet this criterion completely.

The problems of reflected glare have been realized since the conception of artificial light sources, but it is only in recent years that much attention has been directed

*Smoot-Holman Co., Inglewood, Calif.

*Authors

to it. The intent of this paper was not to study and report upon reflected glare. Yet, luminaires in Tables III and IV for offices and school areas, except type *XY*, employed control lenses for the shielding device; and, in every instance, these lenses have reduced the maximum brightness in the reflected glare zone as compared to their counterparts with louvers.

There is no IES standard procedure for determining maintenance factors in time and space (see reference (3) in this paper); and, I quote from Mr. Bradley's own paper[1] ". . . and maintenance factors estimated on the basis of 'terminal' lamp and luminaire depreciation before some maintenance procedure is instituted, as recommended by the Society."

There is no inconsistency in the cost data presented in this paper. Before making any comparisons between lighting systems, all values must be relative. The results in this paper are based on cost per footcandle. The ten to one ratio occurs because the areas are in a ratio of 6.7 to 1, which results in an absolute 1.5 to 1 ratio based on cost per footcandle per square foot. A similar situation taken from Mr. Bradley's paper[1] indicates the ratio to be 1.1 to 1. There was no intent in this paper to compare the school and office lighting systems to each other; for one thing, not all the operating conditions are identical.

To Mr. Neidhart: This paper indicated that the suspension-mounted type-four luminaire could pass the testing procedure of the Underwriters' Laboratories, Inc., and become a listed item. But, for what purpose? For one thing, average brightness would greatly exceed the limitations of the scissors curve. The authors seriously doubt if the luminaire the discusser referred to will meet the scissors curve. As for economics, this paper, too, showed an economic advantage for 1500-ma lamps in the type-four luminaire.

The single- and twin-lamp troffer with 1500-ma lamps is another problem. Without question, such a design with specular aluminum sides and, possibly, even a very deep-white enameled luminaire properly louvered, could meet the scissors curve. But, what of the brightness ratio and reflected glare? Are these important facets in the quality of a lighting installation to be forgotten?

If ballast noise from "C"- and "D"-rated ballasts is definitely not a problem, then why are ballast manufacturers so insistent upon designing and promoting "A" and "B" ratings at all? The only time ballast noise is not a problem is when the ambient noise level of the space is greater than the ballast. When the private office, the library, the classroom, etc., cease to be, then the authors will agree that "C"- and "D"-rated ballasts are not noise problems.

To Mr. Jones: The authors disagree that the information contained in this paper will discourage people from using new approaches. Rather, it will serve to acquaint the designers of lighting systems with the many problems (and accompanying results) inherent when the 800- and 1500-ma lamps are utilized in the luminaire types described in this paper. Fortunately, when a particularly good luminaire design appears on the commercial market, engineers and architects are quick to see the merits. We did not indicate that it was impossible to design commercial luminaires utilizing 1500-ma lamps; type *XY* is proof enough of that.

The luminaire referred to by this discusser is one having a semi-indirect light distribution. Admittedly, seeing with semi-indirect lighting is most comfortable; however, ceiling brightness limits its application. The *IES Lighting Handbook*, 3rd edition, page 10-16, states that average ceiling brightness should not exceed 200 footlamberts. This indicates that, depending upon the exact room surface reflectances, maximum footcandles permissible in an "A"-indexed room will be approximately 200, and in a "J"-indexed room, approximately 60 footcandles, assuming room efficiency decreases to 30 per cent (typical).

In conclusion, the authors were taken to task for stating that the 1500-ma lamp is not currently in wide use in commercial luminaires. Since this lamp was announced some five to six years ago, no manufacturer has developed a recessed luminaire (five-inch depth) or surface-mounted luminaire utilizing the 1500-ma lamp and control lens for a shielding media. Yet, these luminaires with 430-ma lamps are precisely the ones that are being installed today in new offices, schools, etc., as ceiling heights become lower and lower.

Why does the Amick-Bradley paper[1] list the 1500-ma lamp luminaire only once (a suspension-mounted type) in a total of 69 designs? Why does this same paper state ". . . a few luminaires are available for 1500-ma extra-high-output lamps as well?" Why, if the 1500-ma lamp is in wide use? Since the authors clearly stated that "a *limited* number of commercial luminaires utilizing the extra-high-output lamps are available at present;" that "1500-ma ballasts are both too noisy and too large for *unlimited* application;" and, since the discussers have only commented upon luminaire designs less "typical" than the ones in this paper, we contend that the "commercialism" in these discusisons is out of order and this paper stands unflinchingly on its own merits.

1. Amick, C. L., and Bradley, R. D.: "Comparisons of Recessed, Ceiling Mounted and Suspended Office Lighting Systems," ILLUMINATING ENGINEERING, Vol. LVI, No. 11, p. 653 (November 1961).

Gold Medal Nominations Due January 1

General Secretary, Charles L. Amick, invites all IES members to submit nominations for the 1962 Gold Medal award, for "meritorious achievement which has conspicuously furthered the profession, art or knowledge of illuminating engineering." Nominations must be received at IES Headquarters, 345 East 47th St., New York 17, by January 1. Nominees need not be members of the Society or citizens of the United States or Canada.

USING THE SCISSORS CURVE

By EDWARD KROK

A simple explanation of the method of applying the scissors curve to determine the comfort and quality of a lighting installation.

LIGHTING practice and research during the past few years have revealed that higher levels of illumination are desirable. The general trend in illumination continues toward the installation of systems that will provide these levels. However, the advantages that higher levels provide can be nullified if the over-all visual environment is not given careful consideration by the architiect, electrical engineer and others directly concerned with the specification of lighting equipment. Concomitant with the need for these higher levels of light, is the requirement that proper relationships exist among the various brightnesses of the lighting units, room surfaces and room furnishings.

The Illuminating Engineering Society has done an admirable job in providing the tools which make it possible to predict, in advance, whether or not the over-all lighting job will be comfortable and of high quality. All that remains is that these tools be used in workmanlike fashion to provide the desired end result.

Since the manner in which lighting levels and the proper number of lamps and fixtures are selected is well-known, these design considerations will not be discussed here. It is after these decisions have been made that the specifying engineer is faced with the problem of selecting the fixture or fixtures that must answer all requirements of esthetics and lighting performance. Thus, this next, or second, consideration is the examination of a prospective fixture to see whether it has the light flux and brightness distributions that will create the best possible over-all visual environment. Such an examination can be simple and thorough; all it requires is the use of a worksheet which sets up the criteria which must be met.

Printed in black in Fig. 2 (page 695) is one form of such a worksheet. It can be called a Brightness Data Check Sheet. As is readily recognized, this worksheet contains the now well-known scissors curve graph, initiated by IES in the "Recommended Practice for Office Lighting," June 1956 ILLUMINATING ENGINEERING, and subsequently published in the 3rd Edition of the *IES Lighting Handbook*, Section 11, "Offices and Schools." In addition, the worksheet includes a section which examines fixture brightnesses—maximum to average brightness ratio—and, in tabular form, the recommended surface reflectance ranges that must be complied with in the selection of room finishes and room furnishings to ensure that brightness ratios of the room "whole" remain within the most comfortable range.

The worksheet as shown in Fig. 2 lends itself to the following uses:

(1) After the specifying agent selects a fixture which he considers to be a good choice for his particular application, he will request an independent laboratory (not a home factory) test report from the manufacturer on that particular fixture.

(2) Extracting information from the laboratory report, the engineer will determine whether or not average fixture brightness within the visual zone will fall within or outside of the scissors curve requirements. He will also determine whether fixture maximum to average brightness ratios are within satisfactory limits, or excessive. The red printing on Fig. 2 shows how the Brightness Data Check Sheet will reveal its story. (Typical fixture data, Fig. 1, have been used as an example.)

(3) At this point it will be evident that the Brightness Data Check Sheet could and should become a means for establishing a uniform method for:

(a) evaluating lighting units and installations;

(b) providing a quick method by which specifiers can check "or equal" fixture substitutions;

(c) providing substantiating evidence for the acceptance of well designed lighting fixtures and rejection of substandard fixtures;

(d) establishing a format which the fixture specifying engineer can furnish as part of his services to guide the architect and designer in the proper selection of room finishes and furnishings—all of which are equally important components of a properly designed interior lighting job.

AUTHOR: Electro Lighting Corp., Chicago, Ill.

Figure 1. SAMPLE PHOTOMETRIC REPORT

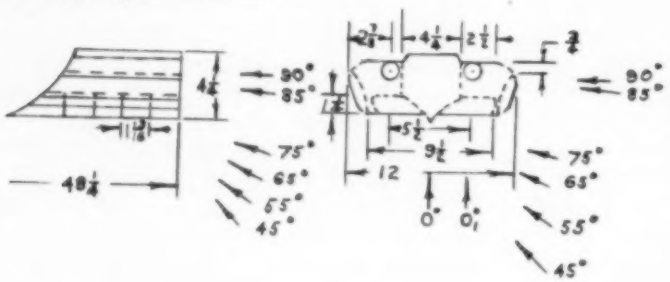
RENDERED TO ABC Lighting Corp.

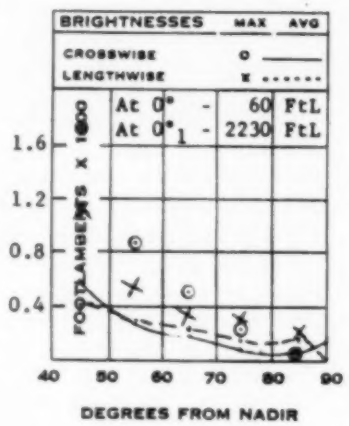
FLUORESCENT LUMINAIRE CAT. NO. 522-RS
TYPE - GENERAL DIFFUSE

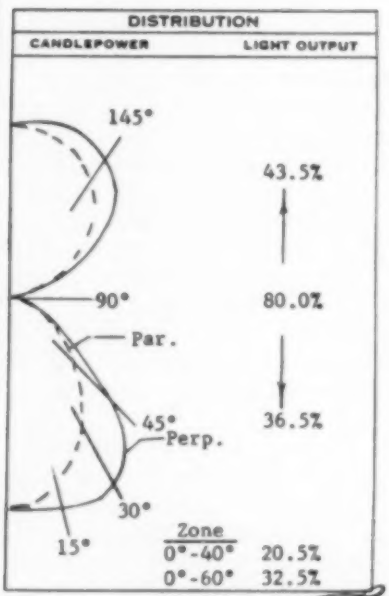
Unit - Synthetic enameled metal housing, cross louvers and indirectly-illuminated sides, reflectance 0.87.
Lamps - Two - 40 Watts; 2500 Lumens; 48" T12 Standard Warm White Fluorescent.
Test - Candlepower distribution in three vertical planes intersecting in the center of a plane through the lamps.

25-foot test distance

Shielding Angles 35°C-35°L







ZONE	MID-ZONE CANDLEPOWER HORIZONTAL ANGLES PAR.	22½	45	67½	PERP.	LUMENS
180°	648		648		648	-
170°-180°	648		651		658	62
160°-170°	632		661		671	185
150°-160°	597		642		668	294
140°-150°	536		605		635	374
130°-140°	457		538		574	406
120°-130°	357		448		438	379
110°-120°	241		291		274	272
100°-110°	122		147		151	150
90°-100°	25.5		46.9		59.2	49
90°	0		23.5		35.7	-
80°-90°	20.4		17.3		17.3	20
70°-80°	75.5		61.2		50.0	66
60°-70°	142		126		128	130
50°-60°	222		270		264	231
40°-50°	357		477		528	356
30°-40°	496		629		788	399
20°-30°	623		720		852	338
10°-20°	731		786		832	222
0°-10°	810		814		816	77
0°	816		816		816	-

TESTED BY H.B PLOTTED BY M.S COMPUTED BY J.J CHECKED BY J.J. ISSUED 9/18/57

REPORT APPROVED BY

MANAGER, PHOTOMETRIC LABORATORY

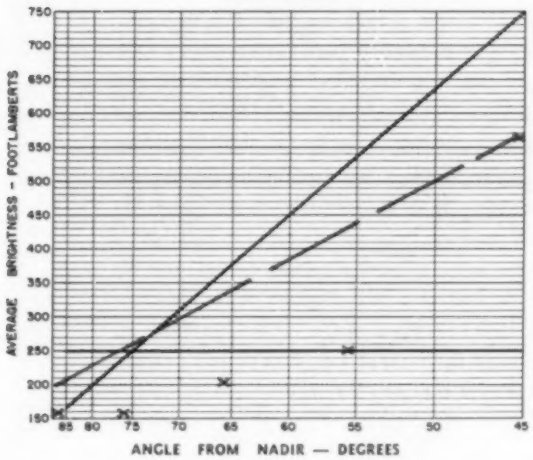
IN CHARGE OF TEST

Figure 2. BRIGHTNESS DATA CHECK SHEET

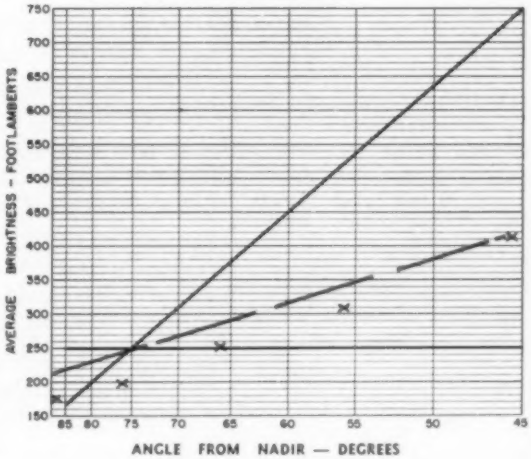
Criteria as per IES Lighting Handbook, Section 11—Offices and Schools

DIRECT GLARE ZONE LIMITING BRIGHTNESSES

CROSSWISE



LENGTHWISE



Direct glare should not be a problem in 30-100 footcandle fluorescent lighting installations if ceiling and wall reflectances comply with recommendations in Tables I and II (below), and if luminaires have crosswise and lengthwise average brightness distributions which fall entirely below any straight lines(s) drawn through 250 footlamberts at 75 degrees lying between the above two limiting solid lines. Fixture #522 RS complies (~~does not comply~~) with such brightness limits since all average brightness values fall (~~do not fall~~) below the reference straight line (long dashes).

TABLE I — Recommended Surface Reflectances for Offices

Ceiling	80 - 92%
Walls	40 - 60%
Furniture	26 - 44%
Office Machines	26 - 44%
Floor	21 - 48%

TABLE II — Recommended Surface Reflectances for Schools

Ceiling	70 - 90%
Walls	50 - 70%
Furniture	25 - 40%
Desk Tops	35 - 50%
Floor	20 - 50%

MAXIMUM TO AVERAGE LUMINAIRE BRIGHTNESS RATIOS

To prevent distracting nonuniformity in brightness, the ratio of maximum to average luminaire brightnesses should preferably not exceed 3 to 1, and must not exceed 5 to 1.

CROSSWISE

Angle	Maximum	Average	Ratio
45°	1700	575	2.9
55°	850	250	3.4
65°	500	200	2.5
75°	250	100	2.5
85°	100	100	1.0

LENGTHWISE

Angle	Maximum	Average	Ratio
45°	1100	400	2.7
55°	500	300	1.6
65°	350	250	1.4
75°	300	200	1.5
85°	200	175	1.1

Fixture #252 RS complies (~~does not comply~~) with recommended ratios.

Fixture Manufacturer ABC Lighting Corp. **Test Laboratory** XYZ

Stroboscopic Effect of Mercury Lamps With Various Ballasts and Circuits

By G. A. HORTON and W. S. TILL

What is the relative stroboscopic effect of mercury lamps? Is it something to consider in the design of a lighting installation where high speed machinery will be used? Is it a factor of importance in the illumination of athletic fields, arenas, or gymnasiums? Will the ball disappear, for instance, just as the player is about to catch it? Questions of this sort are asked perennially, despite the fact that stroboscopic effect has been more an imaginary than a real problem with mercury lamps operated on 60-cycle frequency. Still, the literature, apparently provides no reference to give a relative numerical evaluation for mercury lamps of current domestic design. An investigation was therefore undertaken along the lines followed by Eastman and Campbell[1] in their study of the flicker index of fluorescent lamps, with the purpose of obtaining similar information for mercury lamps.

FLICKER INDEX, as explained by Eastman-Campbell,[1] is the ratio of the area of the light output wave trace above the line representing average intensity or brightness to the entire area under the curve. This is illustrated in Fig. 1. Flicker index is considered to be a useful means of evaluating stroboscopic effect, although Collins and Hopkinson[2] have stated that it is most applicable "for relatively simple wave forms where, for instance, there is no double inflection during one cycle." They have also pointed out, as have other observers, that the perception of flicker varies with individuals, with the size of the visual field, and with the luminance of the visual field, etc. Flicker index can range from zero to one, with the zero value having no flicker. Table I lists the flicker indices that have been calculated for various combinations of lamps and ballasts. In addition to the data for various mercury lamps (including several color types), data are given for a 40-watt incandescent lamp and a 40-watt standard cool white fluorescent lamp. Excellent agreement with Eastman and Campbell's 1951 results was obtained for the 40-watt incandescent lamp, the flicker index being 0.043 in each case. Close agreement was also obtained for the 40-watt standard white fluorescent lamp.

Good agreement was also shown in the relationship of crest and trough values with those of J. A. St. Louis[3] for the A-H1 (H25-HC) mercury lamps. Values resulting from the present study were 160 and 40 per cent compared with the St. Louis results of 163 and 37 per cent, respectively, for crest and trough percentage above base line, where 100 per cent equals average brightness.

In addition, although the types of lamps differ in size and construction, there is basic agreement with the work of Collins and Hopkinson.[2] They found

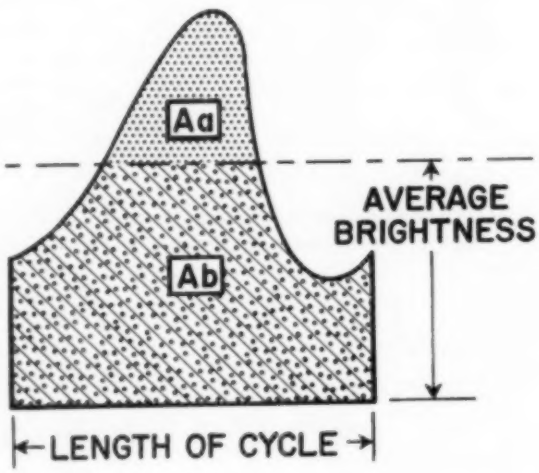


Figure 1. Flicker Index $= \frac{Aa}{Aa + Ab}$, **where** Aa **equals area above line of average brightness and** Ab **equals area under line of average brightness.**

A paper presented at the National Technical Conference of the Illuminating Engineering Society, September 24-29, 1961, St. Louis, Mo. AUTHORS: Westinghouse Electric Corp., Lighting Division, Cleveland, Ohio, and Lamp Division, Bloomfield, N. J., respectively.

Table I—Flicker Index for Various Lamps under Different Conditions of Operation.

TYPE OF CIRCUIT AND BALLAST	NO. OF LAMPS	LAMP TYPE AND FLICKER INDEX H33-1CD (CLEAR)	H33-IGL/W ("WHITE")	H33-IGL/C (IMPROVED COLOR)
60c, 1 ϕ Standard Reactor	1	0.235	0.229	0.198
60c, 1 ϕ Regulated Output	1	0.196	0.184	0.177
60c, 1 ϕ Lead-lag	2	0.136	0.130	0.123
60c, 3 ϕ High p.f. (commercial) Reactor	3	0.027	0.026	0.024
60c, 1 ϕ Series Reactor	1	40-watt standard cool white fluorescent 0.111		
60c, 1 ϕ	1	40-watt standard cool white 0.043		

flicker index values of 0.269 and 0.290, respectively, for phosphor-coated and clear 125-watt quartz mercury lamps of European manufacture, operated with individual ballasts from a single-phase supply. These results compare with our values of 0.198 and 0.235 for 400-watt mercury lamps similarly operated. It is interesting to note that the ratio between flicker indices for American made H33-1CD and H33-1GL/C lamps is 1.18, while that for the European 125-watt lamps measured by Collins and Hopkinson,[2] is 1.08, which is almost the same ratio. Our results for 25 cycles were somewhat disappointing, but this was thought to be due to the fact that the 60-cycle reactor when operated at 25 cycles was found to be somewhat non-linear.

Apparatus

The apparatus used for the study of light output wave form included a vacuum type phototube with filter for approximate correction to the average eye sensitivity curve, a cathode follower type of d-c amplifier, and a cathode ray type of oscillograph. Fig. 2 shows the arrangement of the equipment. The equipment was adjusted for various measurements so that the amplitude of the average brightness was the same on most of the oscillograms. This was done primarily to facilitate computation of the flicker index. On this basis it was not necessary to have a known value of candlepower for the oscillograms. It is to be noted, however, that proper calculation of the flicker index depends very much on obtaining the full development of the light output wave trace. When measuring transient phenomena, it is of utmost importance that the time constant of the phototube to oscillograph amplifier time constant be sufficiently small to prevent distortion of the measured phenomena. This is accomplished by keeping the value of the phototube load resistor as small as possible and the phototube voltage as high as possible, until further reduction in resistance shows no further change in curves of intensity *vs* time.

The light source used for most of the tests was a bare lamp operated in the open without reflector, and for certain tests, two or three bare lamps, operated in a photometric sphere. Readings were taken with the light source operating on 60-cycle frequency from a standard reactor (reference ballast), a regulated output type of ballast, and a lead-lag ballast. Oscillograms for combined lead-lag operation were obtained by operating two lamps in a photometric sphere with the photocell arranged so as to receive their integrated light output. The same method was used to obtain readings for three lamps operated from the individual phases of a three-phase supply system. Oscillograms were also obtained from a ballast operated from a 25-cycle supply. It is to be noted, however, that the Eastman-Campbell flicker index does not hold as a relative measure between lamps that are operated on different frequencies.

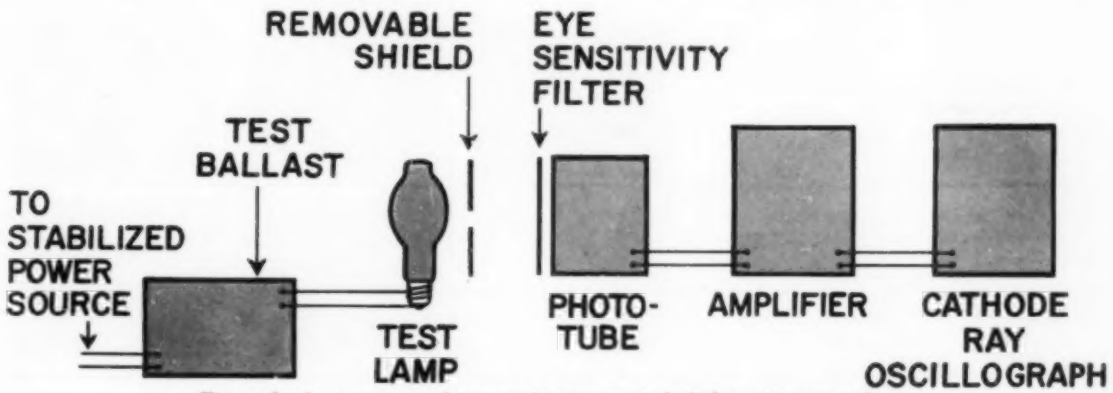


Figure 2. Arrangement of test equipment to study light output wave form.

Fig. 3 shows oscillograms that were taken for three 400-watt mercury lamps: the H33-1CD clear lamp, the H33-1GL/W "white" lamp, and the H33-1GL/C standard white (improved-color) lamp. Fig. 3 also shows oscillograms for the 40-watt standard cool white and 40-watt incandescent lamp. Oscillograms were also taken for 175-watt and 1000-watt mercury lamps of the same color types as the 400-watt lamps. These data are omitted because no essential differences were noted.

Application Information

Jai alai is considered by many to be the fastest game in the world. Yet a number of jai alai courts in Florida have been lighted solely with 400-watt improved-color mercury lamps operated from single-lamp ballasts on a three-phase supply system. There has been no noticeable stroboscopic effect during approximately eight years operation.

There is a softball field in Burbank, Calif.[4] which is lighted with 400-watt improved-color mercury

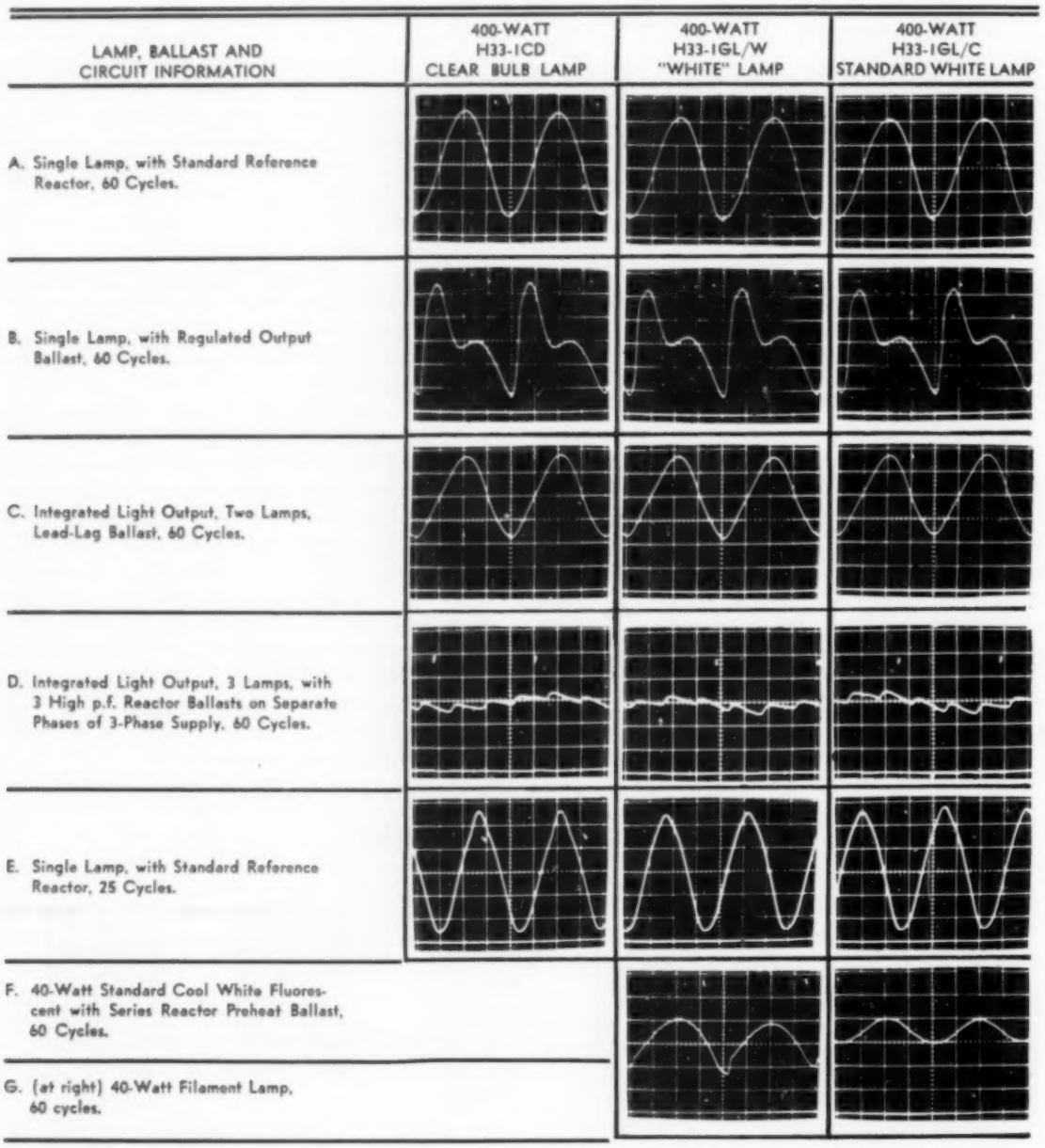

LAMP, BALLAST AND CIRCUIT INFORMATION
400-WATT H33-1CD CLEAR BULB LAMP
400-WATT H33-1GL/W "WHITE" LAMP
400-WATT H33-1GL/C STANDARD WHITE LAMP
A. Single Lamp, with Standard Reference Reactor, 60 Cycles.
B. Single Lamp, with Regulated Output Ballast, 60 Cycles.
C. Integrated Light Output, Two Lamps, Lead-Lag Ballast, 60 Cycles.
D. Integrated Light Output, 3 Lamps, with 3 High p.f. Reactor Ballasts on Separate Phases of 3-Phase Supply, 60 Cycles.
E. Single Lamp, with Standard Reference Reactor, 25 Cycles.
F. 40-Watt Standard Cool White Fluorescent with Series Reactor Preheat Ballast, 60 Cycles.
G. (at right) 40-Watt Filament Lamp, 60 cycles.

Figure 3. Resultant wave forms of light output with different lamp, ballast and circuit factors.

lamps from lead-lag ballasts operated from a single-phase supply system. This, too, has given satisfactory service over a period of almost eight years. Many gymnasiums are similarly lighted. A combination of lead-lag ballasts and three-phase supply has been suggested[5] for even greater reduction in stroboscopic effect.

In machine shops either three-phase single lamp or single-phase lead-lag operation of mercury lamps will furnish illumination that is free of any noticeable stroboscopic effect. This is important where high-speed rotating or reciprocating machinery is used. An example of a machine shop lighted with 400-watt improved-color mercury lamps from three-phase circuits is shown in the article "High Levels in Industry,"[6] ILLUMINATING ENGINEERING, January 1959. Where local incandescent lamps are used at the machine level or are mixed with the general lighting, mercury lamps can be used satisfactorily with single-lamp ballasts, single-phase supply.

Most other applications are less critical with respect to stroboscopic effect, so that it is generally not apparent, regardless of ballast or circuit.

Cost Considerations

Depending upon the design of the installation and other factors, where three-phase power is available, both the cost of initial installation and the annual cost of light can be slightly lower than for single-phase operation. Table II lists cost comparisons, for a typical rectangular-shaped indoor industrial installation, of three-phase, 4-wire, 277-volt operation; single-phase, lead-lag, 277-volt operation; and single-phase, individual ballast, 277-volt operation. Actual costs vary a great deal with each installation.

Conclusions

Effect of Phosphor—Mercury-fluorescent (phosphor-coated) lamps produce slightly less stroboscopic effect than clear mercury lamps. The kind of phosphor used makes a difference. Improved-color types, made with magnesium fluorogermanate phosphor, such as the H33-1GL/C, have less flicker than the "white" color-modified types, made with orthophosphate phosphor, such as the H33-1GL/W. The differences are rather small and by no means as important as the effect of the ballast or circuit.

Effect of Ballast or Circuit—Operation of two mercury lamps with a lead-lag ballast reduces the stroboscopic effect significantly as compared with single-lamp, single-phase operation. Operation of three individually ballasted mercury lamps from the separate phases of a three-phase system reduces the flicker to a very low level (less than that of a 40-watt incandescent lamp operated from a single-phase supply). While this reduction is believed adequate for all applications, a further reduction could be accomplished by connecting lead-lag ballasts to a three-phase supply.

Table II — Cost Comparison for Mercury Lighting Systems Producing Different Degrees of Stroboscopic Effect

Assumptions: Room Index C, 8000 square feet, 20-foot mounting height, design level 55 fc maintained, ventilated high-bay luminaire, 4000 hours per year, one cent per kilowatt-hour, type H33-1GL/C, coefficient of utilization .68, maintenance factor .75 min.

Supply:	1 Ø, 277V	1 Ø, 277V	3 Ø 4-wire, 277V
Ballast:	1-lamp reactor	Lead-lag	1-lamp reactor
Watts per luminaire	435	431	435
Unit Accessory Cost	$45	$39	$45
Unit Wiring & Inst. Cost	$35	$36	$26
Total Initial Cost for 42 Units	$4872	$4662	$4494
Relative Initial Cost	108%	104%	100%
Total Annual Cost	$1680	$1641	$1622
Relative Annual Cost/fc	103.6%	101.2%	100%
Typical Flicker Index (from Table I)	0.198	0.123	0.024

Application Information—Mercury lamps are suitable for use even where very fast motion occurs, if the installation is properly engineered.

Cost Data—The cost of a well-engineered mercury lighting system can be as low as or lower than that of less satisfactory systems.

The authors acknowledge, with thanks, the assistance of M. E. Keck, M. C. Unglert, R. N. Edwards, Jr., and Miss R. Maguire in the preparation of this paper.

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DISCUSSION

J. T. LAUGHLIN:* The introduction to this paper is especially apt. Real "strobe" problems with mercury lamp lighting are, indeed, more imaginary than real. At the same time, the question is truly a hardy perennial.

The flicker indices for various lamps and ballasts under

*Sola Electric Co., Elk Grove Village, Ill.

different operating conditions shown in Table I will undoubtedly become a standard reference for the lighting industry for the future.

The authors very accurately conclude that the lead-lag ballast on single-phase has less strobe than a reactor or constant wattage ballast. Table I flicker indices show an interesting comparison between reactor ballasts and constant wattage ballasts. It is interesting to note that the constant wattage ballast has less strobe than the reactors. But, as the authors demonstrate, the differences in strobe among ballast types are relatively minor as compared to strobe reduction achieved by use of a three-phase system.

I regret that the authors chose to give apparent significance to the use of lead-lag ballasts as a means of "further reductions" of strobe on three-phase systems. Dealing entirely in theoretical terms, they are, of course, correct. However, to put this in proper perspective, it is appropriate to stress the point already made by the authors that with single-lamp ballasts on a three-phase supply, the flicker index is already far better than a 40-watt incandescent. I belabor this point only to keep a specifying engineer from concluding that there would be a discernible reduction of strobe on a three-phase system using lead-lag ballasts.

P. R. HERRICK:* The data in this paper supplements the information on flicker of fluorescent and incandescent lamps presently provided in the IES Lighting Handbook. It should prove quite helpful to those of us who answer the perennial questions on this subject. The oscillograms provided by the authors are in good agreement with our own findings on mercury lamps.

We are heartily in accord with the authors' viewpoint as expressed in the introductory paragraph and implied by the application examples. We could only wish they had stated the case more strongly. Rather than saying the problem is more imaginary than real, we are inclined to the opinion that stroboscopic effect is not a problem at all insofar as human vision is concerned. General lighting during the last five years has been dominated by fluorescent and mercury systems providing little or no stroboscopic correction. During this period of time, we have heard no reports or inquiries concerning difficulties with stroboscopic effect outside of the lighting industry.

M. E. ROBERTSON:** It has always seemed to me that the stroboscopic effect of gaseous discharge light sources is overrated. The very fact that mercury lighting has been used successfully in the critical applications described by the authors would tend to prove this. This paper will do much to put "strobe" in its proper place. Further, for those who are concerned, data are now available for the planning of lighting installations practically free of flicker and at no premium cost.

It is surprising that the phosphors used in coated mercury lamps have so little holdover. It would seem that a greater difference in flicker index between the clear glass and the coated lamps could be expected. What is the reason for this? Could an improvement be realized with different phosphors? It would have been extremely interesting if the authors had included data on the flicker index of the phosphors alone. Were any such data taken?

*Large Lamp Department, General Electric Co., Nela Park, Cleveland, Ohio.
**Jefferson Electric Co., Bellwood, Ill.

The excellent results obtained with three-phase operation were, at least in part, due to total integration of the light from the three lamps in the photometric sphere. In an actual rectangular installation perfect integration would not be achieved. What variation in flicker index from point to point on a horizontal surface could be expected in an actual installation? How would this compare to the flicker index variation on a vertical surface?

W. S. TILL, G. A. HORTON:* Although we are pleased that Mr. Herrick has found good agreement between our oscillograms and those of his laboratory and we concur with his view that stroboscopic effect is not a problem, we do not agree that all clients have stopped worrying about it. Perhaps this paper will be a help in that connection.

Mr. Robertson asked why there was so little difference in flicker index between clear glass and coated lamps. There are two basic reasons for this: first, the phosphors used with mercury lamps contribute a relatively small percentage of the total light output of the lamp, even though they effect a remarkable change in color rendition; and second, a rapid rate fo decay in luminescence is very common with high-temperature phophors. Both the fluorogermanate and orthophosphate phosphors that are used with mercury lamps belong to the high-temperature class. While phosphors vary considerably in their rate of decay of luminescence, there are at present no other mercury lamp phosphors that would be more suitable in this respect. We did not include data for the flicker index of the phosphors alone, since we were interested only in the practical light source, its ballast, and circuit. Other investigators have reported on luminescence *vs* time factors for various phosphors.

Mr. Robertson's question regarding the practical variation in flicker index with three-phase operation, as compared to the total integration of light obtained from the three lamps in the photometric sphere, is difficult to answer satisfactorily. The point to point variation in flicker index on a horizontal surface will depend on the placement of the lamps with respect to the work. n general, in a well-designed installation we would expect that there would be no more than a moderate increase in flicker index as compared to our laboratory operation. This would also be true of the flicker-index variation on a vertical surface, and is dependent on proximity of that surface to any one lamp and its relationship to the other lamps which shed light upon it. The most extreme case would be a light mounted very close to a wall, in which case, the flicker index near any one lamp would approach closely that for an individual lamp operated with an individual ballast. Elsewhere in the room, most vertical surfaces would receive light from a number of lamps, and hence the flicker index would be rather close to that of the integrated group of three lamps tested in the laboratory.

Mr. Laughlin points out that there is no real significance to a proposal to use lead-lag ballasts with a three-phase system of operation. This is true, and we are very glad that he picked up this point. We mentioned it only because it is a theoretical possibility, and one that has been considered by other authors. However, as far as discernible results are concerned, we cannot imagine an application where this further reduction in stroboscopic effect would be of any practical value.

*Authors

Further Appraisals of
LUMINAIRE BRIGHTNESS

By WILLARD ALLPHIN

This paper reports the results of further research in which observers adjusted luminaire brightness in a simulated office to BCD, the borderline between comfort and discomfort. Variations in luminaires and surround were appraised by ten observers who made a total of 750 evaluations. Further data are given for checking glare prediction formulas, and results are reported on the validity of averaging luminaire brightness, on the influence of ceiling brightness, and on the effect of prismatic plastic lenses.

A PREVIOUS paper[1] reported the results of appraisals by 109 inexperienced observers who adjusted luminaire brightnesses to BCD, the borderline between comfort and discomfort, in a simulated office. It was concluded that BCD is a meaningful concept to most inexperienced observers, and that they could make consistent and repeatable evaluations of it. Data were offered by which proposed methods of predicting discomfort glare can be checked.

Three more series of appraisals have been made in order to answer questions raised as a result of the original work:

Series II provided two new situations, for the benefit of those who are particularly concerned with how to add glare sources in a formula. Three of the earlier situations were repeated in order to furnish check points.

Series III asked two questions: Is it permissible to average the brightness toward the eye from a nonuniform luminaire which is off the line of sight? Is it necessary to consider the brightness of the ceiling near the luminaire when devising a formula for discomfort glare—again for luminaires off the line of sight?

In *Series IV*, prismatic lens shielding was substituted for the plastic in two rows and the luminaires were rotated to face downward.

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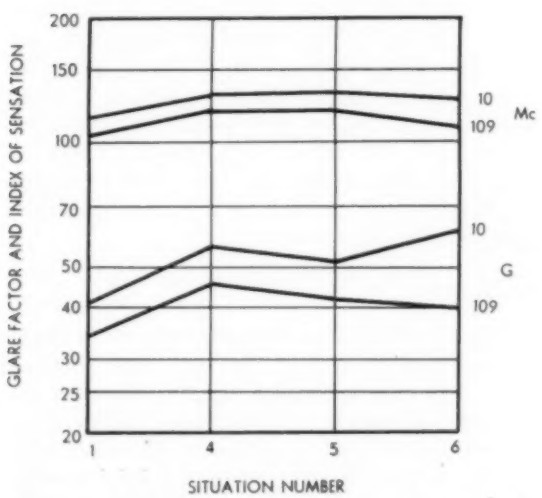

Figure 1. Glare Factors, *G*, and Indices of Sensation, M_c, for 50 per cent of observers comfortable. Series I, from previous project.

Observers

It was not feasible to use the large number of observers employed in the previous project. Instead, ten observers, who were available for further visits,

TABLE I—Situations

SITUATION	NEAR ROW	MIDDLE ROW				FAR ROW
1	Off	Off	On	Off	Off	Off
2	Off	Off	On	On	Off	Off
3	Off	On	Off	Off	On	Off
4	Off	On	On	On	On	Off
5	Off	Off	Off	Off	Off	On
6	On	On	On	On	On	On
7	Off	On	Off	Off	Off	Off
8	On	Off	Off	Off	Off	Off
		BLACK CEILING				
			OPEN	OPEN		
1a	Off	Off	On	Off	Off	Off
7a	Off	On	Off	Off	Off	Off
9	Off	Off	Off	On	Off	Off
10	Off	Off	Off	Off	On	Off
		LENSES				
1b	Off	Off	On	Off	Off	Off
2b	Off	Off	On	On	Off	Off
4b	Off	On	On	On	On	Off
8b	On	Off	Off	Off	Off	Off

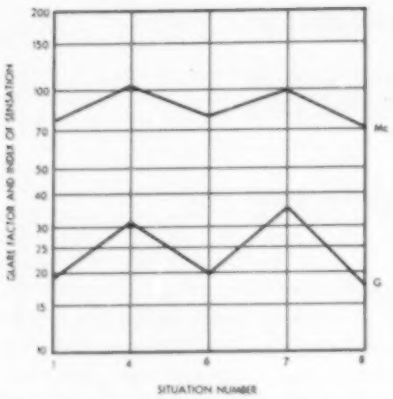

Figure 2. Glare Factors, G, and Indices of Sensation, M_c, for 50 per cent of observers comfortable, Series II.

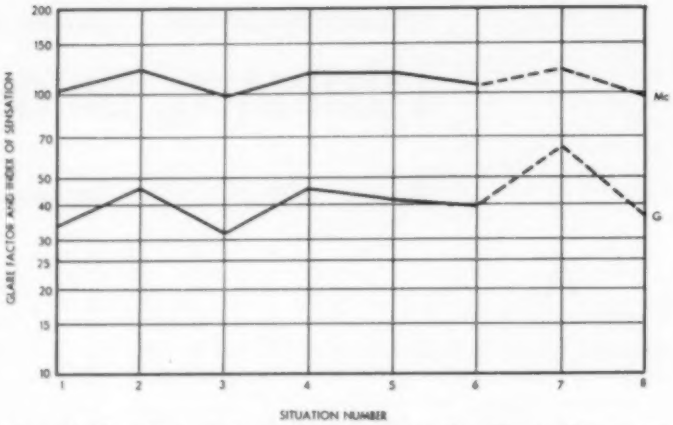

Figure 3. Glare Factors, G, and Indices of Sensation, M_c, for 50 per cent of observers comfortable. Series II prorated to Series I.

whose performance in the previous project had been particularly consistent and whose BCD selections were close to neither the upper nor lower limits of available luminaire brightness, were selected. Interestingly, after they had been chosen on this basis, it was found that they were quite representative of the larger group in their median BCD values. Note the similarities between the small group and the large group in Fig. 1, particularly when the BCD brightnesses have been translated into the Indices of Sensation, M_c, of Guth.[2]

Situations

Table I lists the situations. The six from the previous paper are included because some of them were used again. New situations will be described in more detail as the new series are explained.

Procedure

As in the earlier project, presentations were alternated between low and high initial brightness, and the observer adjusted the brightness upward or downward until it was at his BCD, the borderline between comfort and discomfort. Each of the five situations in a series was presented five times.

Series II

Situation 7 used the first luminaire on the left in the middle row. Doubling the effect of this and making whatever adjustment is provided in a particular glare formula should be equivalent to the effect of Situation 3. Situation 8 used the near row alone. Thus, its effect can be combined with those of Situations 4 and 5 to see if they are equivalent, with adjustment, to Situation 6. Situations 1, 4 and 6 were included for comparison.

Results

Median BCD values were: Situation 1—500 fL, Situation 4—345 fL, Situation 6—175 fL, Situation 7—740 fL, Situation 8—370 fL. Fig. 2 shows these translated into Indices of Sensation of Guth[2] and Glare Factors of Harrison-Meaker.[3] A perfect correlation would produce a straight line, and the values for Index of Sensation lie fairly close to such a line. The values for Situations 1, 4 and 6 in Fig. 2 are lower than those in Fig. 1 because the ten observers chose lower BCD brightnesses as they became more experienced. However, the relationships between Situations 1, 4 and 6 remained essentially similar. Therefore, if the values for Situations 7 and 8 in Fig. 2 are moved upward on the logarithmic scale by an amount equal to the average drop from Series I for Situations 1, 4 and 6, the results of Series II can be compared with those of Series I (the earlier project). This has been done in the dashed lines of Fig. 3. The solid lines show the results of the previous project, translated into Indices of Sensation, M_c, and Glare Factors, G. The values for Situations 1 to 6 in Fig. 3 are slightly different from those published in the previous paper because small errors in computation have been corrected.

Series III

The departures from straight lines in Fig. 3 lead to the question of how the two glare formulas differ. The Guth formula for M_c takes for the surround brightness, the brightness, at eye level, of the wall oposite the observer. The Harrison-Meaker formula for G, modifies this brightness by the brightness of the darkest area of ceiling immediately adjacent to a luminaire. Therefore, the ceiling was painted matte black around the first

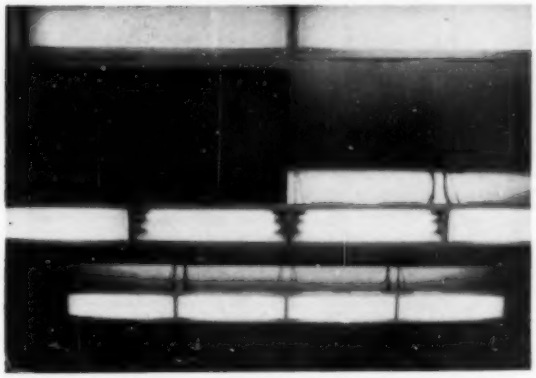

Figure 4. View toward luminaires, Series III. Black ceiling around two luminaires. Plastic removed from two luminaires.

and second luminaire in the middle row, as shown in Fig. 4, to see if the performance of the observers would show a difference due to ceiling brightness.

The use of average brightness for luminaires of nonuniform brightness located off the line of sight has sometimes been questioned. To investigate this, the plastic was removed from the second and third luminaires in the middle row and the middle lamp of each open luminaire was removed. This gave the brightness pattern shown in Fig. 5, for a particular position of the dimming equipment. The area of the opening was 485 square inches. Situation 9 was the same as Situation 1a in regard to angular relationship with the line of sight, and Situation 10 was the same as Situation 7a in this same relationship.

Results

Median BCD values were: Situation 5—180 fL, Situation 1a—300 fL, Situation 7a—320 fL, Situation 9—260 fL, Situation 10—300 fL. Fig. 6 shows these translated into Indices of Sensation, M_c and of Glare Factors, G. The Indices of Sensation remain essentially the same, regardless of ceiling reflectance or nonuniformities of luminaire brightness. The Glare Factors show no difference between uniform and nonuniform luminaire brightnesses, but they do show a marked difference in predictions regarding black *vs.* white ceiling areas. It seems evident, therefore, that the formulas should not consider ceiling brightness.

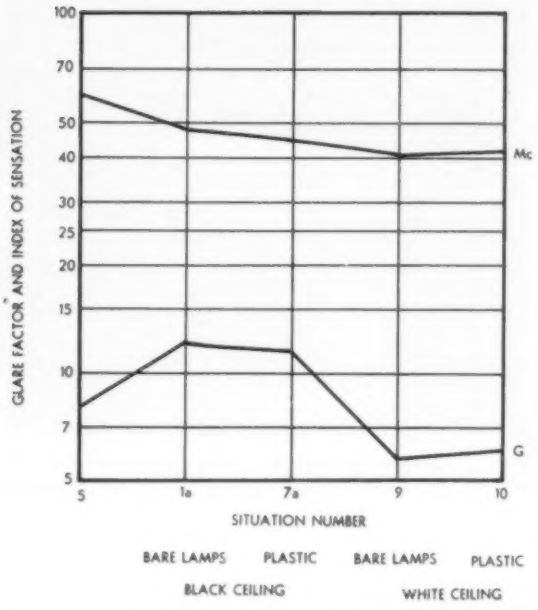

Figure 6. Glare Factors, G, and Indices of Sensation, M_c, for 50 per cent of observers comfortable, Series III.

Series IV

Another question about the use of such formulas for discomfort glare is whether or not they deal properly with luminaires having a strong directional component. With this in mind, the luminaires in the first two rows were rotated so that they faced downward, and prismatic plastic lenses were substituted for the diffusing plastic panels. The far row of luminaires remained unchanged so that Situation 5 could be carried along for comparison. The arrangement is shown in Fig. 7.

Results

Data from the ten observers had about the same distribution for Situations 5 and 8b as had been obtained in previous series. However, the results from Situations 1b, 2b and 4b were rather erratic. For these situations, half of the observers grouped themselves near the high end of the scale and half near the low end. An attempt to indicate this has been made in Figure 8. The points have been plotted to show, not the complete spread, but the

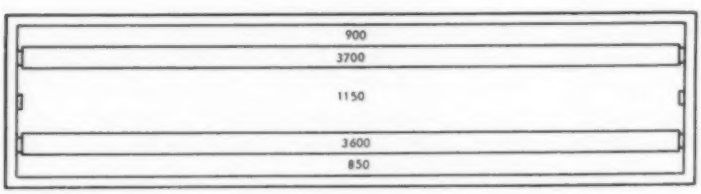

Figure 5. Brightnesses in fL within a bare lamp luminaire. Series III.

Figure 7. Arrangement for Series IV. Near row and middle row rotated to face downward and equipped with prismatic lenses.

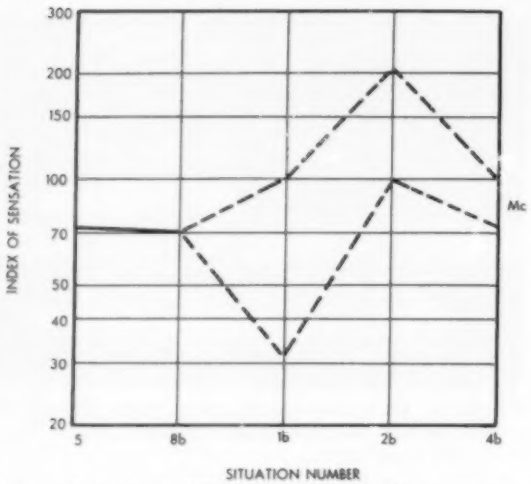

Figure 8. Indices of Sensation, M_c, for 50 per cent of observers comfortable, Series IV.

spread from what might have been expected in a typical distribution. Note that a *lower* value of M_c indicates *more* glare and a *higher* value, *less* glare.

This spread cannot be explained with any certainty, but two factors may be involved. In the first three series, for luminaires in the middle row, the brightness of the side walls in the forward field of view did not differ greatly from the brightness of the fixation area on the wall opposite the observer, and the small changes in brightness as luminaire brightness changed were nearly the same. In Series IV, on the other hand, the luminaires with lenses contributed more to the side wall brightnesses than they had when equipped with diffusing panels facing the observer. Also, in Situations 1b, 2b and 4b, the side wall brightnesses changed more than that of the fixation area. In looking at the fixation area some observers may have been more conscious than others of brightness changes on the side walls. In Situation 8b, where the luminaires were more nearly overhead, the principal effect may have been merely the average brightness of the luminaires.

The other factor is still more a matter of speculation. The lenses in the middle row, provide a noticeable amount of "sparkle" in appearance as compared with the plastic in the far row. Also, there was a subtle difference in paint texture and in the sharpness of outline of the dummy desks. These differences in appearance may have influenced some of the observers more than others. Also, the near row would not have produced as much of this feeling because it was farther from the line of sight and contributed less toward the illumination of objects in the central field of view than did the luminaires in the middle row.

Possible Applications

Table II summarizes the data from all four series as translated into Indices of Sensation and, in part, into Glare Factors. If the Indices of Sensation give a consistent prediction, that is, if the curves for M_c in Figs. 1, 2, 3 and 6 are near enough to being horizontal lines, the results can be combined into the curves of Fig. 9. These show the percentage of a large population which would find a lighting installation comfortable, plotted against the Guth Index of Sensation. The solid line represents inexperienced and the dashed line experienced observers. The percentage factor corresponds to the VCI of Meaker-Oetting[4] and the VCF of Logan.[5]

It can be argude that in so subjective a matter, the first reactions of naive observers are more significant than those of observers who have given repeated consideration to what is or is not glaring. The decision on where to "peg" a limiting curve should probably be left to an applications committee, but wherever located, in a chart such as Fig. 9, it would give a means of setting glare limits based upon the visual situation rather than on luminaire brightness alone.

Conclusions

The following are offered as conclusions:

(1) The addition of two situations similar to those of the previous project did not change the conclusions drawn from that project, and the new situations provided two more check points for testing formulas which predict discomfort glare effects from luminaires in individual units and continuous rows.

TABLE II—Indices of Sensation, M_c and Glare Factors, G, for all Series.

SERIES	SITUATION	M_c	G
I	1	104	34
	2	123	46
	3	99	32
	4	120	46
	5	120	42
	6	109	40
II	7	100	36
	8	72	18
III	1a	48	12
	5	60	8.0
	7a	45	11.6
	9	41	5.8
	10	42	6.1
IV	1b	33-100	
	2b	99-203	
	4b	74-100	
	5	73	
	8b	71	

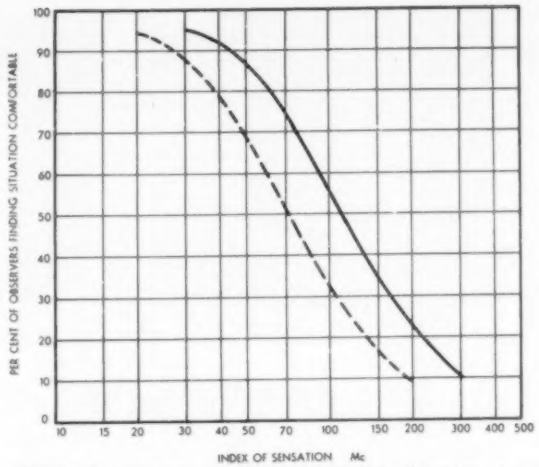

Figure 9. Per cent of observers finding situation comfortable rs Index of Sensation. Solid line—inexperienced observers. Dashed line—experienced observers.

(2) It is proper to average the brightness of the luminaire toward the eye when the luminaire is off the line of sight.

(3) The brightness of the ceiling should not be considered in glare formulas dealing with luminaires off the line of sight.

(4) The Guth formula for Index of Sensation reliably predicts the results for diffusing luminaires in both projects.

(5) Observers did not respond as consistently to prismatic lens luminaires, but the results are probably not so far out of line as to rule out the possibility of applying the Guth formula.

(6) Curves are presented (Fig. 9) which offer a means of establishing limits for discomfort glare from an installation of individual or continuous row luminaires.

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2. Guth, Sylvester K. and McNelis, John F.: "Further Data on Discomfort Glare from Multiple Sources," ILLUMINATING ENGINEERING, Vol. LVI, No. 1, p. 46 (January, 1961).

3. Harrison, Ward and Meaker, Phelps: "Further Data on Glare Ratings," ILLUMINATING ENGINEERING, Vol. XLII, No. 2, p. 153 (February, 1947).

4. Meaker, Phelps and Oetting, R. L.: *Visual Comfort Index and Tables—Their Use in Lighting Design*, Bulletin LS-108, Lamp Division, General Electric Co., Cleveland, Ohio, October, 1953.

5. Logan, H. L. and Lange, A. U.: "The Evaluation of Visual Discomfort Data," ILLUMINATING ENGINEERING, Vol. XLVII, No. 4, p. 195 (April, 1952).

DISCUSSION

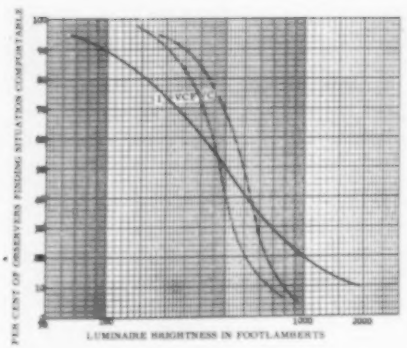
JOHN J. NEIDHART:* This paper provides much-needed answers to some questions which have prevented the Recommendations for Quality and Quantity (RQQ) and application committees from developing a valid, comprehensive method for predetermining comfort. It has proved the erroneousness of at least one of the assumptions that has been built into the calculation of Glare Factors. This substantiates IES' refusal to adopt the Glare Factor system without further data to validate this empirical system. It also points out that promotion of such systems (as has been done by individual companies) is improper.

There are some questions which have not been satisfactorily answered, but perhaps might be clarified by careful study of the unabridged data and discussion with other researchers for possible correlation with their data. For example: What specifically was added in the Series II data to show the equivalence of two Situation 7s to Situation 3 or the equivalence of the sum of Situations 4, 5 and 8 to Situation 6? Why is there such a tremendous difference in the results for Situations 7 and 7a when the only difference between these two situations is the black ceiling and the comparison between Situations 7a and 10 seems to indicate no effect from the ceiling? A similar question can be asked with regard to Situations 1 and 1a, which show quite different results even though the comparisons between Situations 1a and 9 indicate that they should not differ.

More serious questions arise from the erratic data obtained in the Series IV tests, since this type of lighting is more commonly employed than the diffusing type employed in the first three series of tests. The author's suggestion that "sparkle" may be a factor is difficult to accept in the light of his own Series III test results. A possibility not mentioned by Mr. Allphin is the nonuniformity in brightness distribution with respect to viewing angle being a factor since his previous tests indicated that luminaires had approximately the same brightness throughout the viewing zone and hence all luminaires had approximately the same brightness regardless of their position in the visual field.

Mr. Allphin states that it should now be possible to develop a "means of setting glare limits based upon the visual situation rather than on luminaire brightness alone." Knowing the author's viewpoint, I can't help being sensitive to his implication here that the system IES is using (the scissors

*The Miller Company, Meriden, Conn.



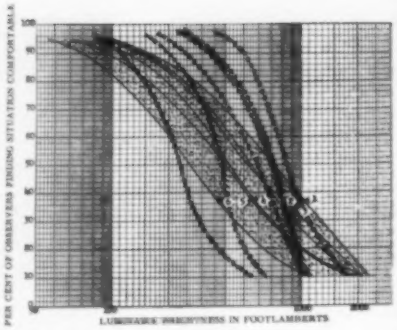


Figure A, far left, Logan discussion. Situation No. 5. Legend: I—Ipswich data. VCF—Prediction of this situation by VCF method. VCI—Prediction of this situation by VCI method.

Figure B, left. Complete VCF predictions compared to observers judgments for Situation 1-6 and Ipswich data. Broken curve indicated VCF predictions Situations 1-6; solid curve—Ipswich data.

curve) is based solely on luminaire brightness. This is *not* the case, for the luminaire brightness limits of the scissors curve are based upon the entire visual situation, *i. e.*, a large room with recommended reflectances and furniture, lighted to a 30- to 100-footcandle illumination level. It is quite improper for anyone to say or imply that the scissors curve does not recognize any visual comfort factors other than luminaire brightness. On the contrary, it recognizes every factor that has been shown to influence visual comfort but simplifies the problem by reducing all variables other than luminaire brightness to a constant representative of the typical conditions that prevail in most lighting installations.

Although this paper brings us closer to the development of a comprehensive visual comfort system, I disagree with the author's apparent feeling that we should now be able to develop such a system. Until another system is developed, I think the current IES system should be supported, regardless of our personal beliefs.

H. L. LOGAN:* This paper is not sufficiently complete to settle all questions considered, but the soundness of using the average brightness of luminaires in making visual comfort predictions is strengthened by these data, as is the use of a fractional power in the summation of the effects of multiple sources.

The effect of luminaire-ceiling contrast is shown to be negligible for the situations used, however the observer did feel uncomfortable in the presence of downlights in a black ceiling. Thus the question, "Do formulas for discomfort glare deal properly with luminaires having a strong directional component?" The data suggest that, all things being equal, such luminaires are judged less glaring; which implies that some present methods of visual comfort prediction based on diffusing distributions distort the values arrived at when applied to controlled distributions.

I had pointed out this probability in the first days of the Harrison glare factor method, but the Allphin data is the first independent concrete evidence to be developed. Comments about "sparkle" and apparent "sharpening" of the field of view under directional lighting show there are subtle aspects of visibility and visual comfort which still need elucidation, and thus more similar data are needed.

For many years, I have observed the greater clarity of a field of view lighted with conventional, directional control, as compared with one lighted by conventional diffusing techniques—where the illumination levels are similar; and discussed this subject in "Bland Environments," August 1960 ILLUMINATING ENGINEERING. These phenomena led me to investigate the auto-correlation technique as a way of measuring them, as reported at last year's IES National Conference.[1] More data are needed on the phenomena of "sparkle" and visual "sharpening."

In Mr. Allphin's previous paper, "BCD Appraisals of Luminaire Brightness in a Simulated Office," (January 1961 ILLUMINATING ENGINEERING) he compared, in Fig. 14, his observers' data, and predictions by the VI and VCF methods, for his Situation No. 5. The VCF curve was incorrect (through no fault of Mr. Allphin's) and this discussion gives an opportunity to present the correct data.

The corrected version of Fig. 14 is given here as Fig. A, and the VCF prediction for all of Mr. Allphin's six situations is given in Fig. B. The curves of Fig. A show that the observers judge slight glare more severely than the predictions, and judge considerable glare less harshly. The VCF curve crosses the observations at about 53 per cent, and the VCI curve at 37 per cent. This means that VCF values above 53 per cent are more lenient than the observers' judgments, and VCI values are more lenient above 37 per cent. Below these respective values both predictions are more severe than the observers' judgments. Concerning Situation No. 5, VCF predictions come closest to the observers' judgments, in the region upward from 46 per cent.

The complete VCF predictions covering the judgments of Mr. Allphin's observers, shown in Fig. B, are surely in the general range of the observers' judgments; and show that approximations of a fairly satisfactory level can be made this way. It is, of course, more desirable to get a higher order of approximation where possible, and the data indicate that closer approximation will be developed.

1. Logan, H. L., Berger, E.: "Measurement of Visual Information Cues," ILLUMINATING ENGINEERING, Vol. LVI, No. 6, p. 393 (June 1961).

WARD HARRISON:* Mr. Allphin correctly points out in Fig. 2 that Glare Factors (G) show a greater variation from the hoped-for horizontal line than do Indices of Sensation M_e. This is, of course, to be expected since M_e is a direct function of source brightness but glare factors are proportional to brightness squared. To bring both systems to a common basis I have added a third curve to this chart (broken line Fig. C) which is the square root of the glare factors with one decimal place pointed off on the vertical scale. It will be observed that this additional curve and the M_e curve are very consistent.

There is one feature of Mr. Allphin's BCD measurements which is questionable. The ten observers used in this year's test started out in 1960 about 15 per cent less sensitive to glare than the average of all 109 observers. Their M_e equivalent then was about 130. This year, the ten observers became considerably more sensitive to glare and their M_e equivalent was about 90. Dr. Hopkinson found a similar

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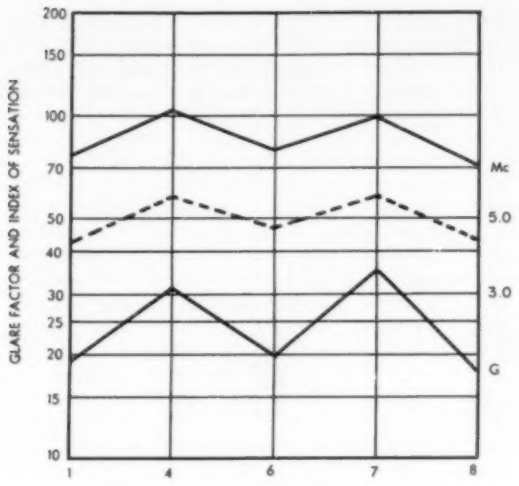


Figure A, Harrison discussion.

trend in his British research, but indicated that his observers stabilized in six or seven weeks.

What concerns me is that when Allphin's observers came to the task of appraising just one luminaire, as in Situations 1a, 7a, 9 and 10, they became radically more severe in their judgment so that their M_c equivalents were 41 to 48 and glare factors 6 to 12. In other words, for BCD they demanded brightness about one-third of what they chose a year ago. Is it not possible that to make an absolute determination of BCD is much more difficult in the case of a single light source at a considerable angle from the line of sight, than where there is a continuous row of units symmetrically placed with reference to the line of sight? Series IV (if these were the final tests), would seem to give some support to this hypothesis for in tests 5, 8b and 4b, where a whole row of fixtures was again observed, the M_c values fell between 71 and 100, near this year's starting point.

As to the effect of black ceilings on discomfort, I would not want to take a definite stand at this time. Most lighting people do not consider the severe contrast with the luminaires pleasing. Some say it's distracting, others—uncomfortable. I believe that an entire black *vs* white ceiling in a room with a complete conventional lighting system would afford a more conclusive basis for evaluation than we have had to date.

WILLARD ALLPHIN:* Dr. Harrison's demonstration of improved correlation as a result of taking the square root of the glare factors is interesting, but still leaves the question regarding ceiling influence unanswered. In this connection, also in reply to Dr. Logan, I do not maintain that a black ceiling would be desirable. Black was chosen as an extreme for the area involved, yet our observers apparently were not influenced by it. To have used an entire black ceiling would have been prohibitively expensive, because of the need to carry over one or more situations from a previous series. To make the comparison within one series would have required either two rooms, side by side, identical except for ceiling color, or it would have involved some elaborate arrangement of "flip-flop" ceiling panels, black on one side and white on the other.

Dr. Harrison comments on the general change in observer sensitivity from one session to another. I have felt that the general trend meant merely that observers chose lower BCD brightnesses as they became more experienced in making judgments, but it is true that the trend was upward in the final series. Perhaps this indicates the approach of the stabilization mentioned in regard to Dr. Hopkinson's observers. On the other hand, seasonal and weather factors could have had an influence, particularly where many of the observers came from outside the plant. At any rate, they were consistent within each series which, in my opinion, makes their data usable for most purposes.

I cannot agree with Dr. Harrison that the ten observers were more severe in judging a single luminaire than a row of four. Fig. 2 in the paper gives the results from Series II for the ten observers. It is true that Situation No. 1 is lower than Situation No. 4. (No. 1 is the second luminaire from the left in the middle row and No. 4 is the entire middle row.) However, Situation No. 7 is for another single luminaire (the first one in the middle row). It is even further off the central line of sight, yet it has practically the same value as No. 4 (the whole row). Thus, it seems to me, that the departures from a straight line in Fig. 2 are merely what can be expected in so subjective a matter. Note also that although the variations are greater, the directions are the same for the Harrison-Meaker Glare Factor, G, as for the Guth Index of Sensation, M_c.

In reference to Fig. A of Dr. Logan's remarks, I would note that the slopes of the curves are more important than the points at which they cross the 50 per cent line. The VCF curve has the same slope as the VCI curve because they were based on the same BCD data of Guth. My observers spread more than Guth's; therefore, the curve is less steep.

Mr. Neidhart comments on the impropriety of individual companies using glare systems which he does not like. I do not feel that commercial procedures of particular companies should be discussed in a formal paper before a National Technical Conference or that they should be any concern of the IES as a professional society.

Answering Mr. Neidhart's questions: It is the glare formulas which provide the addition. An observer will choose a higher BCD brightness for one luminaire than for two, but it will not be twice as much. The glare formula translates the two brightnesses into glare numbers, which should be equal if observations and formula are reliable.

The BCD brightness in Situations 7 and 7a cannot be compared directly because they are from different series. As explained in the paper, the observers chose lower values in Series III than in Series II, but within each series they were consistent. Thus the effect of the black ceiling area cannot be evaluated by looking at the raw footlamberts for Situations 7 and 7a. However, Situations 7a and 10 were in the same series, and here the observers did choose substantially the same brightness.

Regarding Series IV, I have pointed out in the paper that the spread of data cannot be explained with any certainty, and the suggestion of "sparkle" is only speculative. However, the nonuniformity in brightness distribution with respect to viewing angle was allowed for. The brightnesses in Series IV were measured average brightnesses toward the eye in each case. I might better have said: "Means of setting glare limits *utilizing* the visual situation," instead of "*based upon* the visual situation." I realize that the scissors curve is based upon the Harrison-Meaker glare formula, applied to an assumed visual situation, but after various adjustments and simplifications, it becomes a rather rigid device. Since Mr. Neidhart has brought in the scissors curve, may I say that I dislike it because, *as presented and used*, it takes account of only the luminaire brightness.

Finally, I do not believe that one must rigidly refrain from criticizing anything in the society's published practices.

*Author.

DISCUSSION—of previously published papers

Comparisons of Recessed, Ceiling-Mounted, Suspended OFFICE LIGHTING SYSTEMS—C. L. Amick, R. D. Bradley†

JOHN J. NEIDHART:* The questions and decisions discussed in this paper are problems that are faced by lighting designers every day, and the approaches and the information provided should be helpful in pointing the way toward intelligent selections of the best lamps and luminaires for given applications. The reader should be cautioned, however, against making general conclusions based upon the limited data provided, for similar studies involving luminaire designs other than those covered in this paper or using different burning hours or energy rates, as they will often lead to quite different conclusions than might be drawn from the data presented in this paper. As a matter of fact, the 1½-cent energy rate strikes me as being a little low on a national basis for office areas.

It was interesting to note the authors' comment, "Slimline lamps eight-feet long have been employed to a limited extent for 12-inch wide flange and snap-in troffers, but such luminaires generally use four-foot enclosures for easier handling and maintenance." I agree with this statement but find it difficult to understand why they limit this reasoning to troffers. It is just as applicable to ceiling-mounted and suspended equipment, and we have never been able to understand why anyone would want to try to handle and maintain eight-foot closures for any type of lighting unit.

†November IE, p. 653

*The Miller Company, Meriden, Conn.

The emphasis which the authors have placed on visual comfort is commendable and I am sure that we all agree with their statement that, "No goal of luminaire selection is more important for office areas than to minimize glare." I most certainly do not agree, however, with their method of comparing relative comfort. I think that it is high time that individuals and individual companies desist in the use and promotion of whatever visual-comfort system strikes their fancy, instead of supporting the standards of IES. The glare rating system which the authors have consistently employed in this and other papers has been thoroughly studied by appropriate IES committees on which the authors have served or on which their interests have been represented by others having similar views. Until now, these committees have found glare ratings, VCI's, and VCF's unacceptable as Society standards for many reasons which I will not attempt to go into here. Despite this, the authors and their associates persist in using and promoting these badly misunderstood numbers that are derived from assumptions and unproved formulas. While the authors are promoting glare ratings, others are promoting their pet systems, all of which yield different results. It is no wonder that the public is confused.

It is not that IES has no official guide for designing comfortable lighting systems or appraising luminaire brightness, for we have the "scissors curve" which was developed and approved by the Office Lighting Committee in 1956 and reaffirmed again in 1960, with the approval of Council on both occasions. More recently, it has also been approved by the School Lighting Committee, the American Institute of Architects, and the National Council for Schoolhouse Construction for inclusion in the forthcoming Guide for School Lighting. The authors have served on these committees and opposed the scissors curve, but were overruled by the majority. They are entitled to their personal preferences and beliefs, but I plead with them to join with the majority in presenting a united Society front to eliminate the growing confusion that they and others are fostering. It is no different from disagreeing with IES on recommended illumination levels and going out and promoting other levels that each of us might prefer. It is not any different from each of us calculating coefficients of utilization by methods other than the IES-approved method and thereby having coefficients from different manufacturers that are not truly comparable. The same reasoning also applies to other-than-standard nomenclature.

Let's continue to argue the relative merits of various systems in our committee meetings and at our National Conferences, but let's set our individual viewpoints aside and unite to support our agreed-upon IES practices and recommendations in our local and regional IES meetings, in our literature, and in all our conversation and dealings with the public.

One final point. The authors have included in Table III the maximum brightness at nadir "as an index of the problems likely to be encountered from reflected glare." Some of the latest researches seem to indicate that it is not the brightness of the reflected source that is the cause of much of the reflected glare problem. Instead, it seems to be the percentage of the total illumination at the work point that is contributed by the luminaire or luminaires in the position to cause the reflected glare. I therefore suggest that we do not overemphasize the role of maximum brightness from the standpoint of its effect on reflected glare.

STEPHEN S. SQUILLACE:* Office lighting system comparisons as presented by the authors of this paper indicate an accurate and well correlated set of data for consideration when lighting an office building. A spot check of initial costs as shown on page 654, Table I indicates that they agree closely with our own figures for similar lighting systems in similar environments.

It is a general feeling in our office that combination light and air troffers are still in their infancy and much remains to be done before data are gathered and correlated so that such a system may be properly identified as another prototype for office lighting systems. Such systems have been designed, but they have been specially applied and no formal data are yet available to properly categorize such units. The authors should qualify the several statements about combination light and air troffers.

On page 655 the authors state that, "Progressive lighting recommendations should not ordinarily hinge on aspects of economics anyway, since visual comfort and esthetics are so important in office areas." I am in thorough agreement with this sentiment; however, in my 15 years of practice, I have never found an owner who puts esthetics before economy for the type of buildings described here. Indeed, a more practical view should be that progressive lighting actually hinges simultaneously on all three factors, economics, comfort and esthetics, in that order. The greatest challenge of this day is to use sharp, imaginative and fundamental thinking so that these three factors come out on equal planes, complimenting instead of fighting one another.

The hours of usage of 3120 per year as stated in the paper seem low compared to Detroit area practice which seems to be in the neighborhood of 4000 to 4800 hours per year. However, such usage is in favor of the authors' comments and seems to strengthen the belief that higher output lamps and higher footcandle levels are not as costly to operate as one might think.

The figure of $100 per ton for air conditioning costs needs clarification since our mechanical engineers talk about $500 per ton as being more representative; this figure being greater than that stated by the authors.

In the case of the two-lamp, 24-inch wide troffer efficiency and the use of higher output lamps, I would like to point out that while the 24-inch two-lamp troffer is excellent and should be used for comfort reasons, there is often trouble locating these fixtures due to room sizes and shapes that do not lend themselves to taking full advantage of the 14 per cent wattage figure used in the paper. Such figures often result in increased footcandles which is good, but not a real, tangible saving.

In the case of the eight-foot and four-foot higher output lamps for low-ceiling areas, such units are not really economical except in increase of footcandles over a given footcandle level. For example, four rows of two-lamp, 40-watt rapid-start units might produce 50 footcandles in an eight-foot ceiling, eight or nine feet on centers. Two rows of eight-foot, 1500-ma units might give the same 50-footcandle level at 18 feet on center and this cannot be tolerated with respect to distribution. Thus, while the costs shown in Fig. 3 are accurate comparisons with respect to costs, they do not present the complete lighting picture.

Since the advent of 1500-ma lamps, improved-mercury lamps, and the quartz iodine lamps, the electrical engineer has, at his disposal, a variety of tools which can be used for direct and totally indirect systems in separate enclosures which are definite flexible factors resulting in the achievement of better coordination of architecture and lighting.

By comparing the higher output lamps and neglecting the possibilities of mercury, io-line and any other appropriate sources, the authors have excluded at least a fourth system of office lighting which will influence office lighting techniques in the very near future. Such a fourth system will bring the higher output lamps into proper focus for comparison with the three schemes presented in the paper.

W. S. FISHER:* IES analyses agree that a pattern of lighting costs develops as luminaires designed for more lamps per unit or lamps of higher light output are used. For the luminaires typically considered by users, our comparisons show that luminaires employing 1500-ma lamps will range from 10 per cent to 30 per cent lower in initial cost than those employing the same number of lamps of lower loading. Over-all costs may range from about the same—in the case of the newest F40 lamp now available—to about 15 per cent lower. However, first cost may often be given more weight and be the overriding factor among all the other purely economic considerations in a particular case.

The authors have introduced two new "angles" into their analyses not often found. One, credit is given for the ceiling tiles saved with 2-foot-wide troffers as compared with 1-foot-wide units; and two, credit for differences in air-cooling requirements is applied. Both angles are realistic and emphasize that lighting design is not unrelated to the rest of a building design.

This relationship serves to remind us that we may also look forward to the time when we can evaluate in dollars and cents, the worth of a lighting system as a heat source in commercial and industrial properties where the electrical space conditioning concept of integrated system design is employed.

I concur with the authors regarding the desirability of a comprehensive visual-comfort rating method and am glad to see such information in economic analyses as an automatic reminder that factors other than pure economics should be weighed in selecting a lighting system. The use of two curves showing limiting glare factors for various types of tasks is interesting as a way of conveying a better understanding of visual comfort to users and specifiers. I presume these curves must agree with the authors' experience in evaluating the comfort of specific lighting systems.

However, the word description of the upper curve bothers me since it is described as suitable for a task where the view of the work is more downward than usual, perhaps when work is performed in a standing position. Actually, glare factors assume that the line of sight is horizontal and they are an indication of the degree of comfort with which people may look about an area. This horizontal direction of view may involve looking at some visual task, or it may be simply a brief respite from looking at a difficult visual task on a desk or drafting board. The brief respite and horizontal view may also occur with the visual tasks performed while standing.

The "percentage-of-people" method for expressing comfort evaluation, has in my experience, been more understandable to practitioners, specifiers and users of lighting equipment than any other method. This avoids some of the difficulty in interpreting word descriptions. In the commercial field where we are concerned with the visual comfort of many people, it covers the range of suitable lighting equipment very well.

We can all look forward hopefully to the time when the IES has a Society-approved *comprehensive* and easily-understood comfort evaluation method so that manufacturers may provide proper data for their luminaires as automatically as they provide coefficients of utilization, price lists, etc.

C. L. AMICK AND R. D. BRADLEY:* Mr. Neidhart cautions against general conclusions about lighting costs. Economic comparisons should, wherever possible, be based on the specific luminaires, ener-

*Hyde and Bobbio, Inc., Detroit, Mich.

*General Electric Co., Nela Park, Cleveland, Ohio.

*Authors.

gy rates, burning hours per year, and other particular conditions applying to a given proposed installation. This method, discussed extensively in a paper by Barr and Amick,[1] was employed in calculating the lighting costs.

We are in general agreement with the use of eight-foot slimline lamps. However, luminaires can and have been designed where the mechanical problems of enclosure length are minimized, enabling the use of eight-foot sections with easy installation and servicing, good appearance, and inherent economic advantage.

The balance of Mr. Neidhart's comments deal with our use of the glare factor system to show relative comfort. We sincerely believe that the Annual National Technical Conference *is* a proper platform for discussing IES policies and procedures. We hold inviolate the privilege of free discussion, and are sure Mr. Neidhart shares this conviction.

The glare factor system was used in the paper because it permitted a numerical assessment based on the specific width, length and ceiling height of the particular general office, the specific room-surface reflectances assumed, and the particular illumination level to be provided. The glare factor method is believed to take better advantage of available engineering data on direct-glare comfort *for specific interiors*, than the "scissors curve."

We concur with Mr. Neidhart's statement on reflected glare and await further knowledge on proper methods to evaluate veiling brightnesses.

We appreciate Mr. Squillace's confidence in our cost values. We agree that air-handling troffers are "in their infancy" and thus, did not include cost and comfort data on such equipment. However, many installations have been completed and we feel that laboratory data and field experience adequately justify the selection of air-handling troffers.

Concerning the comments on burning hours in the Detroit area, very possibly we have not made sufficient allowance for overtime and cleanup periods. The figure of $100 per ton of air conditioning was a typographical error in the preprint, and should have been $1000 per ton, which will more closely agree with Mr. Squillace's experience.

We feel that mercury lamps are not sufficiently color-balanced for most commercial interiors. To produce 100 or more fc with quartz-iodine incandescent lamps would introduce discouraging problems of air-conditioning load.

Mr. Squillace's comments on the simultaneous consideration of economics, comfort and esthetics certainly represents the practical solution to the selection of lighting equipment, and many other items to be specified for a building. We would be pleased to see engineers and designers give visual comfort the same attention as economics.

Mr. Fisher's assumption is correct that the two curves (suggesting appropriate glare factor values) are based on personal experience. The upper curve is based on observation that many industrial workers, and those doing casual tasks of filing, stocking, etc., in commercial areas, are in a standing position, with a predominantly downward direction of view. Often such workers also have shorter periods of concentration on critical seeing tasks, compared with desk or drafting-board employees. In our experience, such standing workers, or others with less prolonged concentration on difficult task details, do not require the same level of direct-glare control as do many types of office work. Incidentally, we would be agreeable to a glare evaluation system which expressed the percentage of people who considered the installation comfortable.

1. Barr, A. C., and Amick, C. L.: "Fundamentals of Lighting Cost Analysis," ILLUMINATING ENGINEERING, Vol. XLVII, No. 5, p. 260 (May 1952).

BALLAST THERMAL PROTECTION—D. Lovinger†

FRED ABRAHAMS:* The author has presented an unbiased description of the causes and conditions resulting at end of life ballast failures.

He has indicated admirably the differential that must be made between excessive current and excessive temperature which quite often may occur at end of ballast life. These factors show with great clarity the possible problems which may occur in the use of fusing *vs* thermal protection within a ballast.

Mr. Lovinger has stated that ballast failures can show themselves as resulting either in excessive current, excessive temperature or a combination of both. He has also shown the advantages of a thermal-type of protector in coping with the problems resulting from excessive temperature as the most common type of failure which may not be accompanied by excessive current. However, while he has made a distinction between the fast acting fuse and the slow-acting fuse, he leaves the impression that all thermal protectors operate in the same manner. It would be desirable to indicate that there is a type of thermal protective device which would react to failures which are accompanied by both temperature increases or current increases, or a combination of both. This is the thermal-responsive, automatic-reclosing type of thermostat which has its elements so constructed that the temperature response varies with the current passing through the device. It is a repetitive device, and as such, should be distinguished from the single-acting, one-shot thermostatic link.

With the automatic-reclosing type of device, as current increases, the temperature at which the device will function becomes progressively lower until in the vicinity of six amperes the device opens at room temperature. Others may be obtained with varying characteristics, depending upon the line current of the ballast being protected. This type of device cannot be considered solely as thermally responsive and should actually be considered in a separate category since it combines the features of both the fuse and the thermal protector. It is also desirable to add, in this respect, that due to its resetting ability, this type of thermal device may be designed to open at considerably lower temperatures than those that are permissible with a single-operation thermal device.

Mr. Lovinger's paper considers the failure pattern of a ballast at the end of life. He discusses this pattern on the basis that all ballasts will fail at the end of normal useful life. This paper is titled "Ballast Thermal Protection," and as such, it would have been desirable if Mr. Lovinger had considered the problem of premature ballast failures and what causes these failures.

From the standpoint of the end user of fluorescent lighting, it is most desirable that he be afforded a measure of protection against premature failures as well as protection at end of ballast life failures. There are various factors which can cause premature ballast failures; high supply voltage, lamp failure, pinched wires, or luminaire improperly designed or improperly mounted so that the heat of the ballasts and lamps cannot be adequately dissipated. All these conditions cause a ballast to operate at excessive temperatures.

As mentioned, a ballast will receive 12 to 15 years of life if the insulating material is not stressed beyond 105°C. If the material is stressed by excessive temperatures, the life of the ballast will be cut in half for every 10°C rise above the 105°C limit. Some means of protection must be offered for these conditions. There are other types of faults which the author has covered in his paper, such as the shorted-cathode winding as shown in Curve *5*, Fig. 2, of his paper. This is a type of fault which could very readily occur externally to the ballast. Other types of faults could be caused by a pinched lead or grounded leads on the high-voltage side of the ballast. As shown with a shorted-cathode winding, temperatures in excess of 150°C may be created. Under these types of faults will the single operative thermal responsive

†October IE, p. 611

*Advance Transformer Co., Chicago, Ill.

device be actuated? If it is actuated, will there be a nuisance failure? If it is not actuated, how much will the ballast life be shortened? Much has been made of the problems that have occurred with the fast-acting fuse causing nuisance failures. These in the past have been rather costly from the standpoint of replacement. Such a problem cannot be overlooked and must be considered by the ultimate user. The author mentions that the records did indicate that no violent failure of a fixture had occurred when the fixture had been properly fused. We would like to know whether any record is available at all as to the number of installed luminaires this represents. Is it not possible that due to the infrequency of violent failure and the relatively few number of fused luminaires in use today as compared to the total number of luminaires, that this statement has been allowed to carry too much weight?

Mr. Lovinger has given a very good description of failure pattern of capacitors which fail due to either voltage puncture or thermal runaway. He has neglected, however, to mention a third failure pattern which has been the one which we believe will not be repeated again, but has been the primary cause of present-day interest in ballast protection. This type of failure, which occurred a number of years ago, was due primarily to the presence of imperfect or contaminated oil within the capacitors. Under these circumstances, it has been found that failure of a capacitor by complete breakdown may occur rapidly without any material increase in temperature of the capacitor. In many cases, emission of oil was observed even prior to energization of the ballast. It should be pointed out that this type of failure would cause the emission of oil and potting compound even prior to any possible operation of a fuse or thermal protector.

The circumstances under which capacitors are now being manufactured are different. The quality control and testing methods that have developed since this time indicate that the condenser within the ballast will probably be the last of the components to fail within a properly designed ballast. It would be most desirable if it were possible to tabulate figures which would indicate the relative per cent of failures which originate in the capacitor as against those that originate in the transformer section itself. In view of these figures, the merits of capacitor protection could then be better evaluated.

Possibly, one of the regulatory bodies or one of the agencies involved in the lighting industry could obtain records which would present an over-all inclusive report on the incidence and causes of ballast failures. It would be very illuminating to include in this report figures which would show the incidence of premature failures and their causes.

M. E. ROBERTSON:* I agree with the author entirely on certain of the broad concepts, such as the desirability of luminaire protection and the great future of the fluorescent lighting industry. However, in reviewing the paper, I must disagree with the first paragraph. The author states that someday every fluorescent lamp ballast must fail. This assumes that there will be no luminaire obsolescence—that once a luminaire is installed, it will stay installed until the last ballast in the installation reaches its end of life. Will this be 20, 30 or 40 years?

Various types and degrees of ballast component failure are described. However, their comparative frequency is covered only in very general terms. It would have been interesting had the author quoted statistics based on field experience as to the percentage of quiet failures, leakage or visible evidence failure, and smoking or luminaire eruption failures. Of these last two, how many were due to what component failure? How many were due to condenser case rupture caused by thermal runaway? Are there statistical data available comparing thermally-protected ballasts with unprotected ballasts on these points?

The author has demonstrated the need for thermally sensitive devices by showing that some ballast failures manifest themselves initially in the form of increased temperatures with no increase in line current. If such failures were allowed to progress, the insulation system would break down, the line current increase, and an external fuse blow. The ballast would be removed from the circuit before fireworks resulted since, to quote the author, "Records to date indicate no violent failure when a luminaire has been properly fused." High temperatures could be reached as demonstrated in curves *1*, *2* and *3*. High temperatures are undesirable since the compound in black asphalt-filled ballasts could come out of the ballast. This possibility is completely eliminated in ballasts using a thermosetting type of fill material. Such a ballast, with external individual fuse, meets all requirements set forth by the author for the first two types of ballast failure.

The author points out that most capacitors fail either open or shorted and present no problem. As a capacitor ages, its ability to withstand voltage decreases and it will eventually break down and fail shorted. With a properly-made capacitor, operated within its design limits, we believe there is no sharp rise of dissipation factor with time as described by Mr. Lovinger. This incidence of thermal runaway is, therefore, rare if it occurs at all.

The inclusion of a thermal fuse in the capacitor itself seems a questionable, unduly complicated solution to a problem. The rare thermal runaway may cause a capacitor case rupture or may simply result in a shorted capacitor. Of all the causes of capacitor leakage, those resulting from ruptured cases due to thermal runaway, are certainly in the minority. The thermal fuse in the capacitor then does not prevent capacitor leakage but only acts as protection against capacitor case rupture which may be caused by thermal runaway.

A leaking capacitor is not in itself particularly objectionable. It becomes obnoxious when the escaped oil mixes with many times its own volume of compound and the whole mess comes out of the ballast and luminaire. If a capacitor oil leak develops in a ballast utilizing thermosetting-fill material, then only clear oil comes out of the capacitor and a small amount (if any) may escape from the ballast. Isn't this a simpler but more complete solution?

We cannot help but wonder just how the fuse in the capacitor functions. The author mentions temperatures of 300–400°C inside the capacitor. Does the whole inside of the capacitor get this hot? If not, how can the hot area be anticipated and confined to the location of the fuse? At what temperature does the capacitor fuse link blow? What is the capacitor case temperature at this time?

Most certainly, branch circuit protection, individual ballast protection, and protection against personal and property damage are desirable and are to be strived for. It appears that internal thermal link protection in the ballast and capacitor with black asphalt-filled ballasts is a very complicated way of accomplishing these desired goals.

D. N. INGWERSEN:* The author has discussed several techniques for preventing some types of ballast failure. Unfortunately, none of the devices can be guaranteed to prevent all such violent failure. It would seem therefore that more work must be done in this direction before the lighting industry can recommend any of the devices available today without explaining their weak points.

As Mr. Lovinger says, in the end the light user will pay for any and all protective devices. If we take industry statistics on ballast production of the certified type, approximately one million units per month, the consumer will pay approximately $150.00/month for the lowest priced device, offered as protection against approximately one undesirable failure per month. This would seem to be very high

*Jefferson Electric Co., Bellwood, Ill.

*Sola Electric Co., Elk Grove, Ill.

priced insurance for violent failure at end of life, particularly if the "one chance in a million" is a factual statement.

Perhaps it would be more in order to recommend some type of fusing for those installations that have a facility for producing trouble, such as surface-mounted luminaires on acoustical ceiling material.

GERALD MARKS:* The author has brought into focus the many facets that have to be considered concerning ballast thermal protection. The only positive way to eliminate the problems caused by ballast heating is to design luminaires and ballast combinations where all the ballast heat can be properly dissipated. Certainly the trend toward shallow equipment with its accompanying demands on ballast compactness is the greatest cause of ballast heating problems. It might also be pointed out that not only does the modern trend cause ballast heating problems but also affects the economies of lighting. Generally this compactness reduces the light output of the lighting luminaire with an accompanying increase in the over-all cost of light.

As an adjunct to luminaire design, more consideration should be given to better testing techniques with a regard to heat. Certainly the ballast hot spot does not give a *complete* picture of the heat problems that can arise in a piece of lighting equipment. Beyond the ideal approach to the problem, the practical aspect of the situation seems to lie in the increasing demand for ballast protection. My experience indicates that this trend is not caused so much by the demand for protection as much as the desire for convenience in identifying a faulty luminaire. Although fusing doesn't give 100 per cent results, it does do a satisfactory job in this area. For this reason, the dual element external fuse seems to be satisfactorily economical and does give the adequate protection and convenience that is desired.

D. LOVINGER:** I would like to treat Mr. Abrahams' and Mr. Robertson's discussions as one since they cover the same general areas.

First, some clarification of my statement relating to the absence of violent failures when protected by luminaire or ballast fuses needs to be made. Admittedly, our data on this subject are quite limited. However, our experience with the amount of information that has been fed back to us, both through our field service engineering group and our own direct investigations, relating not only to our own ballasts but to those of our competitors, has formed a rather definite pattern. Let it suffice to say that the only instances where fire or luminaire eruptions have occurred have been with luminaires that have not been fused. Specifically, we know of a large luminaire manufacturer who has been fusing his recessed luminaires for more than ten years with no reports of either fire or fixture eruption in these fixtures. As could be expected, however, he has had some incidents of difficulty with his unprotected luminaires.

Most of this is past history, and one of the points that I attempted to make in my paper is that fusing and current sensitive protection is no longer a guarantee against violent failure. The newer series-lead circuits are designed, in many cases, to operate for long periods of time with excessive temperature without excessive increases in input current. This could conceivably result in fire or luminaire eruption before adequate current rises had occurred to remove the ballast from the line. For example, a ballast may have a complete short of the secondary winding, that could cause it to burn up and start a fire, and still not produce abnormally high input currents. To this point, all high-power-factor ballasts not equipped with some form of thermal protection, and regardless of the kind of filling material used, can conceivably fail violently.

I did not mean to slight the current-sensitive thermal protectors that are available for use; rather, I only attempted to distinguish between the kinds of protection needed. These current-sensitive thermal protectors are well-designed and effective devices that do have some advantage in being both current and temperature sensitive. However, the resetting or recycling feature disturbs me because of the possibility of continually aggravating a minor fault by returning the ballast to the line time after time. It is conceivable that with the right circumstances, restarting of a faulty ballast could cause some form of violent failure. In addition, if it is inferred that the current-sensitive resetting thermal protectors solve all of the misapplication problems, I would suggest, for example, that a trial be made applying 480 volts to a 277-volt ballast protected in this fashion and determine which goes first—the ballast or the current-sensitive thermal protector.

With regard to Fig. 2, Curve *5* was slightly in error. The particular measurements made on the 2-lamp 40-watt rapid-start ballast equipped with a shorted cathode winding in a reasonably hot fixture only rose to 130°C, as shown in Fig. A (a corrected version of Fig. 2). More importantly, the temperature was measured immediately below this cathode

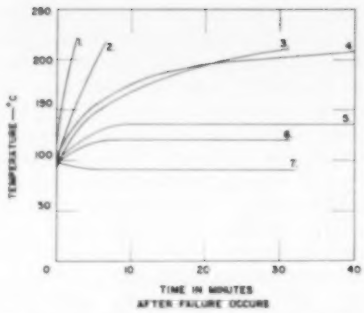


Figure A. Temperatures of a particular location in a two-lamp 40-watt rapid start ballast under various conditions of failure. 1. One-layer short in primary; 2. Shorted power and starting capacitor; 3. Shorted power capacitor; 4. One-layer short in secondary; 5. Shorted cathode winding; 6. Shorted R.I. capacitor; 7. Shorted-starting capacitor.

winding where the overheating was occurring. A thermal protector of almost any type could not be placed this close to the source of heat, and, as a result, would in most cases continue to allow the ballast to operate even though the fault had occurred. This would be true whether the fault were internal or external. In the case of some of the ballasts equipped for higher current operation, the damage would be more extensive, the temperature rises more severe, and as a result, the thermal protectors would, of necessity, have to remove the ballast from the line. All thermal protectors need to be capable of removing these ballasts, since by the time the excessive temperatures had been sensed by the protector, they would already have caused damage that would have severely shortened the ballast life.

Our past experience, especially in the last few years, has developed a pattern of component failure that placed special emphasis on the limitation of the ballast power capacitor. Since the unfortunate difficulty of several years ago, great strides have been made by the capacitor manufacturers in improving their techniques and quality-control procedures to greatly minimize the possibility of this kind of difficulty occurring again. However, I say "minimize;" because of the critical nature of this device, there still remains the possibility that such difficulties could conceivably occur again, either from a similar cause or a completely unrelated one. Specifically, the unstable impregnating material used in 1956 and 1957 did manifest itself as a thermal runaway failure, although the outward evidence might have appeared to be that of a dielectric puncture.

Figs. B and C cover the subject of

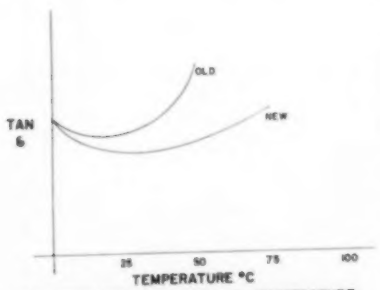
*Electro Silv-A-King Corp., Chicago, Ill.
**Author.

thermal runaway. These curves in Fig. B describe the variation of dissipation factor of an oil-impregnated capacitor, as a function of temperature. The lower curve describes a new capacitor, whereas the top curve shows the shift and rise in power factor or dissipation factor after a long period of service. Fig. C describes the heat dissipating characteristic of the capacitor container as a function of both temperature and dissipation factor.

The internal heat generated is proportional to the dissipation factor of the capacitor. In turn, each capacitor can's heat dissipation is a function of its surface area and, in turn, can be plotted as temperature rise vs watts-per-square-inch. As a result, line Q_D describes the heat dissipation characteristic of a particular capacitor container operating in a 70°C ambient. The curve that describes the heat dissipation characteristic of a new capacitor intersects the heat dissipating characteristic of the container. Therefore, this capacitor will operate essentially at this intercept. As has been noted on Fig. C, the capacitor dissipation factor will shift and rise over a long period of time until such time as its internal heat exceeds the heat dissipating capability of the container. The net result is thermal runaway.

In talking about thermal runaway, it is important to understand that even though a capacitor experiences extremely high temperatures in the center of the roll, perhaps as high as 300–400°C, with internal pressures of 250–400 psi, and the capacitor container temperature may not rise very much above its normal operating temperature by the time the capacitor failure occurs. It is because of this extreme temperature differential that capacitor manufacturers can develop a protective device that will actuate at these extremely high temperatures and yet allow the capacitor to perform its normal function. When the temperatures and pressures indicated occur, more than capacitor impregnant leakage may result.

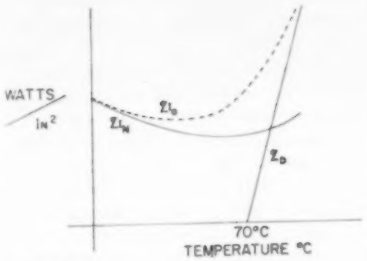
In the past we have broken down the



CAPACITOR POWER FACTOR VS TEMPERATURE

Figure B. Power factor or dissipation factor of new and old oil-impregnated capacitors vs temperature.

CAPACITOR THERMAL RUNAWAY



$Q_I = K \tan \delta$

Q_D = HEAT DISSIPATING CHARACTERISTICS OF CAN

Figure C. The operating characteristics of both an old and new oil-impregnated capacitor as a function of temperature. The interception of QI_N and Q_D indicates the point of operation of a new capacitor in a 70°C ambient. Thermal runaway of the old capacitor designated by QI_O indicates that this capacitor will thermally run away in the same 70°C ambient.

causes of ballast failures in a manner that would place emphasis on the potential weakness associated with the ballast power capacitor. Our past data would indicate that the failure pattern would look something like this: 85 per cent capacitor failures, 10 per cent opens due to open coils or leads or other components, less than 5 per cent shorted coils. This includes normal wearout, not just premature or early failure. We are sure that with the improvements in capacitor technology, the percentage of failures attributable to the capacitor has reduced sharply. At the present time, it is much too soon to predict how great this shift might be. Certainly, it is safe to say that ballast life has been extended as a result of these capacitor improvements.

I think Mr. Mark's comments regarding the current situation in the lighting industry are particularly appropriate. However, as I have said earlier in both my paper and discussion, the ultimate lighting user can no longer be guaranteed 100 per cent protection with just ballast or luminaire fuses.

Most ballast failures are peaceful and cause no outward evidence of failure other than lamp outage. My discussion pertains only to the small percentage of failures that are violent. In this respect, I agree with Mr. Ingwersen, but I must remind him that even a one-in-a-million failure can extensively damage the fluorescent lighting field's reputation.

In summary, I would like to make it clear that my primary interest in making this presentation was not to discuss the merits of one manufacturer's protective features in comparison to another, but rather, to make sure that the lighting industry clearly understands that there is a problem and that there are ways to protect against these difficulties.

COMBATING JUVENILE DELINQUENCY WITH LIGHT—Alexander Lurkis†

D. A. TOENJES:* The author has thoroughly described the lighting equipment and the resulting illumination, for a specialized application. The paper may be expected to find effective use as a guide whenever lighting is to be done for this specific purpose.

The paper makes clear that the present lighting is not designed for specific games, but only for security. Approximately what portion of the total number of playgrounds is actually intended for night use? If many of the playgrounds are intended for night use, does the Park Department have any plan for additional lighting in some of the enclosed areas for specific sports? However, if most of the playgrounds are *not* intended for night use, why is good color rendition important? Wouldn't it be preferable to use phosphor-coated mercury lamps having the "white" rather than the improved color characteristics, to obtain maximum light output from each installation?

Under "Interior Lighting," the author states that the low mounting height of these units prevented the use of mercury lamps. Instead, 230-watt incandescent lamps were used. Would it be practical to use the same luminaire with 175-watt phosphor-coated mercury lamps? If we assume that the 230-watt incandescent lamp is a street lighting lamp design, then substitution of the mercury lamp, would offer about twice the light output, four times the average life, and ten per cent lower total wattage, even including the ballasts. Even when the lamp and ballast costs are considered, improved lighting economy might thus be achieved.

Apparently one reason for using the reflector-type of mercury lamp was the need for lightweight and low initial cost equipment. Although the original owning cost thus is lowered, the operating cost for a given footcandle level can usually be reduced by using mercury lamps of the conventional type in enclosed floodlighting equipment. This reduction is chiefly because of the reduced lamp-replacement cost—lower individual lamp cost, and probably less malicious breakage. Would the author comment as to the estimated life of the lighting system? Was a break-even time explored after which conventional lamps in floodlighting equipment might begin to show lower total owning-and-operating cost of light?

†October IE, p. 606

*General Electric Co., Nela Park, Cleveland, Ohio.

ALEXANDER LURKIS:* In reply to Mr. Toenjes, regarding plans for additional lighting other than security lighting for parks and playgrounds, it must be remembered that the security lighting will be in use during the entire night-burning cycle, approximately 4100 hours a year. Supplementary application lighting will be furnished and installed for specific games, but this supplementary lighting will burn only a few hours a week compared with the longer period required for security lighting. As to the importance of good color rendition and the preferability of white color rather than the unimproved-color characteristics lamp, I mentioned in my paper the desirability of using improved color in the playground lamps, although the lamp selected had practically no color correction. While it is desirable to have color correction, unfortunately no such lamp was available with the lighting characteristics required. The color correction is desirable inasmuch as clear mercury lamps have a disastrous effect on women's complexions. If such an improved-color lamp were available, a white color would be desirable.

Mr. Toenjes questions the use of a 230-watt incandescent lamp. Since the writing of the paper, a unit has been developed for the utilization of the 175-watt mercury lamp. This design is protected by an inner cage which is believed to be vandal-proof and contains a reflector which has proved effective in the better distribution of light.

Lastly, concerning the reason for not using conventional floods, I have indicated that one of the major factors in selecting this specific lamp was that in 80 per cent of the cases, tree penetration was a requisite. Also, the lamp life is 12,000 hours, and the small target area of the lamp enclosed in its hood has proved to be a low cost maintenance item. Another important factor is the small visual field provided by the light source. This is essential in view of the location of these playgrounds adjacent homes and residential areas.

Operating Characteristics, Environmental Testing and Circuit Applications of PLASTIC ELECTROLUMINESCENT LAMPS—J. C. Devol†

R. J. BLAZEK AND P. F. DIETZ:** To be valuable for potential users of the flexible-type plastic electroluminescent lamp to which the paper relates, additional data on the dependence of brightness on applied voltage and frequency would be most useful.

The data presented substantiate the results obtained in the past by other investigators with both rigid and flexible plastic-type lamps which contain organic dielectrics for phosphor embedment.[1-4] Consequently, it is desirable to include references to previously published accounts of similar effects, such as, the detrimental effect of temperature on maintenance, the beneficial effect of series resistance on maintenance, the extension of life by increasing applied voltage, the increase in luminous efficiency during lamp operation, and maintenance of constant light output through gradual increase in applied voltage.

The conditions of 75°F, 85 per cent relative humidity were relatively mild in comparison to the humidity cycling conditions specified by the military services.[5] Furthermore, the lamps would be subjected to higher ambient temperatures and humidities than the stated environmental tests with outdoor exposure in various geographical locations. Are data available on the performance of the subject plastic lamps under a more stringent test, *e.g.*, 122°F and 95 per cent relative humidity? The comparison of a metal panel with the plastic one under the stated humidity conditions must have been made with early metal panels lacking adequate protection against moisture penetration. Our tests do not indicate such results.

Undoubtedly, the composition of the vapor barrier employed and designated in the paper as "subject lamp envelope" is proprietary information and cannot be divulged. However, the comparison between the "subject lamp envelope" and polyethylene and chlorotrifluoroethylene homopolymer was so favorable that it would be of great interest to determine whether the reference was to an equivalent thickness of plastic in the lamp envelope, and whether the plastic employed in the "subject lamp envelope" was a specially developed or a commercially available material.

It should be noted that the data on brightness and maintenance presented by Mr. Devol for flexible-type plastic lamps are not representative for all types of electroluminescent structures. Within our experience, rigid type green-emitting lamps have been constructed which exhibit higher brightness and substantially longer maintenance of output than the corresponding plastic lamp in the subject paper operated under identical conditions. This is the result of fairly recent technological developments in the preparation of phosphor and high dielectric constant organic embedding media. Would the author care to make a similar comparison between the performance of flexible and rigid structures drawn from those within his experience?

We agree with the final paragraph in the paper where it is stated that many applications for electroluminescent lighting will come in areas which are today not even recognized as possible areas of application.

References

1. Roberts, S.: "Aging Characteristics of Electroluminescent Phosphors," *J. Appl. Phys.*, Vol. 28, p. 262 (February 1957).
2. Thornton, W. A.: "Electroluminescence Maintenance," *J. Electrochem. Soc.*, Vol. 107, No. 11, p. 895 (November 1960).
3. Ivey, H. F.: "Problems and Progress in Electroluminescent Lamps," ILLUMINATING ENGINEERING, Vol. LV, No. 1, p. 13 (January 1960).
4. Blazek, R. J., Wollentin, R. W., and Bullinger, H. B.: "Multilayer and Flexible Single-Layer Electroluminescent Lamps," ILLUMINATING ENGINEERING, Vol. LVI, No. 3, Section II, p. 195 (March 1961).
5. USAF Military Specification MIL-E-5272A, Amendment-1, (July 1955).

J. C. DEVOL:* Regarding the dependence of brightness on applied voltage and frequency, the electroluminescent lamp generally exhibts a linear relationship between the logarithm of brightness and the reciprocal square root of applied voltage. Note Fig. 5. For more specific information, see Figs. A, B and C included below.

The choice of the 75°F and 85 per cent relative humidity environment was based on the survey, "Climate Control Project" conducted by *House Beautiful*. In the survey, the average vapor pressure encountered each month of the year in 15 geographical areas in the United States was converted to an average vapor pressure for the year in each area covered; then assuming the barometric pressure to be constant, the values were converted to per cent relative humidity at 75°F. Typical results follow:

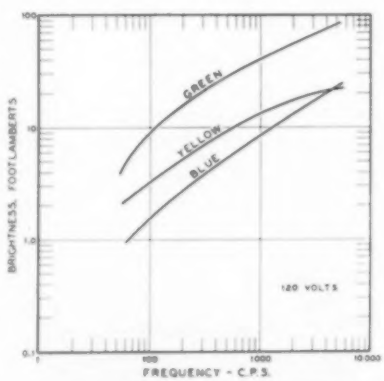


Figure A. The effect of frequency on brightness.

†October IE, p. 621

*Author.

**Westinghouse Electric Corp., Bloomfield, N. J.

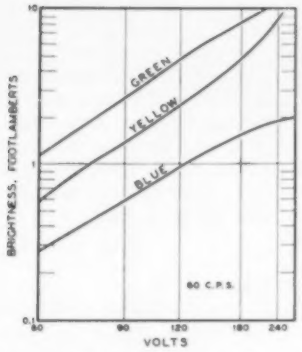


Figure B. The effect of voltage on brightness (60 cps).

Location	Percentage Relative Humidity
Denver, Colo.	17.5
Southwest	28.3
Mid-Mississippi Basin	31.4
Portland, Ore.	33.2
New York, New Jersey	35.0
Washington, D. C.	35.5
Charleston, S. C.	59.8
Gulf Coast	66.0
Miami, Fla.	80.0

Since the most severe condition was the 80 per cent relative humidity encountered in Miami, 85 per cent was selected as a sufficiently high test value to assure coverage of the entire continental United States.

The lamp envelope suffers no physical damage because of ambient temperatures as high as 300°F. However, there was a question regarding the effect of ambient temperature on the water vapor permeability of the lamp envelope. The average temperature encountered in any area would be the criterion here, since low temperatures will tend to lower this value, just as high temperatures will increase it. The average temperature of Miami, Fla., is 75°F.

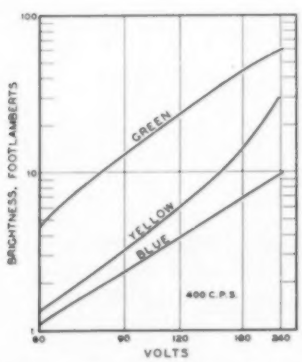


Figure C. The effect of voltage on brightness (400 cps).

Testing at 122° F, 95 per cent relative humidity represents an increase of approximately 300 per cent in vapor pressure over the most severe conditions found in the continental United States. This may be a good forced humidity test, but would have no effect on the lamp under discussion other than to reduce the approximate hours of lamp operation free of humidity effects (Table I).

The data in Table I refer to actual performance of three types of lamps identical in all respects except for the envelopes. In the first two cases, the envelope consists entirely of .005-inch polyethylene or chlorotrifluoroethylene. The envelope of the third case consists of the actual material and material thickness used in the subject lamp. As for the nature of this envelope, I cannot comment except to note that the lamp incorporating this material is only 22/1000 of an inch thick. Therefore, an excessive amount of the material is not used.

In regard to improvements in phosphors or dielectric matrix materials, I have observed developments in these materials which, when *successfully* incorporated in the subject lamp, would result in brighter, longer-lasting lamps.

Design Considerations in a SMALL, MULTI-USE AUDITORIUM—Alston Rodgers, W. D. Riddle, R. T. Dorsey†

EDWARD F. KOOK:* Although the lighting layout in principle mirrors an abundance of good ideas and interesting innovations, the space plan for the auditorium and stage reflects something less.

Even though it is stated that the platform is not suitable for dramatic presentations, I do challenge so shallow a depth as eight feet. I also dispute the assertion that there is adequate offstage space on both sides. This will not allow storage of stage properties, small sets or scenery; nor will it permit rapid changes. On the other hand, if one is to acknowledge the fact that rigid space limitations were imposed, this might have been a good place to introduce the use of a high-powered wide angle lens projection machine which would provide appropriate scenic backgrounds and additional lighting effects.

While it is claimed that the auditorium was designed for adaptability, just how can it be readily converted into a conference room? Just how would one dispose quickly of the armless chairs and store them readily? What, in the design of platform mobility, enables it to be maneuvered into other appropriate arrangements? To what is this "multi purpose auditorium" most conducive? Can it be rapidly altered to function as a hall for a fashion or machine show?

As for color in material: It is noted that the curtains are described as light neutral color with patterns of light brown, old gold and white. Blue light alone cast upon these curtains will mute the brown color and cause it to change to black. How then is it possible to obtain a total blue sky effect? Nor does the stage lighting layout include spotlights on overhead pipes and on tormentor positions located on either side offstage. The absence of spotlights at these points prevents backlighting, side lighting and overhead lighting, all of which are essential to heighten three-dimensional plastic lighting.

The different light sources and their electrical controls easily provide ways to obtain many atmospheric lighting effects. The lighting scheme with its special structural ceiling space-frame offers a new and exciting method and opens the door to a wide variety of techniques in order to achieve unusual results.

R. G. WILLIAMS:* One of the most interesting features of this auditorium is the provision of multi-color lighting to produce variable environmental effects. The desirability of viewing different colors simultaneously has been recognized, and separate dimmer controls have been provided for all lights.

In order to produce an adequate range of color effects—especially for color music—a wide choice of hue, chroma and value is necessary; otherwise, adjacent areas may have colors in which the basic hues are in harmony, but are otherwise discordant because of wrong relationships of chroma and value.

Adjusting the magnitude of value presents no difficulty, since all lights are on separate dimmer controls. Hue and chroma, however, are problems, because the colored lamps used as sources of colored light in this auditorium have wide spectral distributions and, in combination, produce even more desaturated colors.

The separate areas of illumination vary considerably in size; for example, the mobile-color screen is smaller than the stage curtain. To obtain color balance and harmony, it is necessary to be able to produce deep colors with a high degree of saturation. This cannot be done by blending the light from the colored incandescent and fluorescent lamps now in use. On the other hand, the desired deep colors, as well as tints and desaturated colors can be easily produced by blending the light from properly selected hues of colored light, as for example, red

†November IE, p. 661

*Century Lighting, Inc., New York, N. Y.

*Century Lighting, Inc., New York, N. Y.

with a wave length range of 640-760 millimicrons, green with a range of 490-550 millimicrons and blue with wave lengths ranging from 430-470 millimicrons.

This can be done in the case of the stage curtains here using clear PAR-type lamps in standard stage borderlight equipment whereby each lamp is compartmented and provided with a color filter. Since a four-color arrangement is in use on the first border, the circuits could correspond to red, green, blue and white. Such a setup would produce an almost complete range of deep colors and tints. The stage spotlights in the auditorium could then be used for accent lights with even greater effect.

The mobile-color screen is at present illuminated by green, gold, pink and blue fluorescent lamps. It is appreciated that a red, green and blue system would be difficult with fluorescent lamps because of its low output of red light. However, the required red can be produced from suitable tungsten filament sources with color filters. Then the green, gold and blue fluorescent lamp can be retained for the other three colors. The blue lamps, however, should be used behind deep blue filters.

If deep saturated colors are available for the stage curtains and mobile-color screen, the color lighting for the auditorium walls and ceiling can be left unchanged, since paler colors with a relatively limited range of hue then would be acceptable on these larger areas.

When changes of colored light accompany and express the mood of music, it is desirable to control the speed of change. A manually-operated, preset control system would be preferable to fixed-speed motor dimmers in this respect, particularly because of the difference in the rate of brightness change for fluorescent and incandescent sources. However, while the fastest speed is fixed at six seconds, it is possible to slow a dimming change by "inching" the motor control button. There is a definite art in mobile color lighting even when detached from a musical accompaniment. It is imperative that so important an auditorium as has been described in this paper be in keeping with the highest levels of knowledge and experience concerning luminous color. It is in this spirit that my remarks are made, and I hope that they will be helpful in showing how the basic system presented in the paper can be utilized for even better effects.

ROSE COAKLEY:* To the best of our knowledge, this is a first in the use of variable transformers to control the quartz iodine lamp and the ultraviolet lamp. It is interesting also that because of some forty 2000-watt motor-driven controls, it is always possible to blend from one lighting system to another—without abrupt change.

One of the most dramatic effects achieved is that of starting from almost zero footcandles and gradually increasing the brightness of the fluorescent-treated ceiling by increasing the amount of generated ultraviolet light with these variable controls. Another feature of the control system is the ability to use both control stations simultaneously, giving maximum flexibility during the course of "effective presentations."

We note the point has been made that conditioned air is introduced in the side walls *below* the level of the lamps and lighting troughs. We would like to emphasize that the effect of air movement on the efficacy of fluorescent lamps becomes even more critical when they are dimmed.

It is no doubt true that few small auditoriums could justify such an elaborate installation as this. However, there is a real need for more auditoriums in our larger cities with this kind of built-in flexibility so that lectures on lighting effects and sensations can actually be experienced by the audience.

R. T. DORSEY:* This installation was designed primarily to serve the immediate purposes of a meeting place and lighting demonstration for visitors to Nela Park. We readily concede that, in general, auditoriums for municipal purposes—schools, trade shows, etc.—need more off-stage space, a greater variety of stage lighting, and greater facility in lighting control.

The gold curtain consists of small "facets" which reflect light both specularly and diffusely. The fabric responds to light in much the same way as do the old techniques of "pointillism" or "spattering," where small areas of material effectively reflect each color of light.

While greater saturation of primary colors can produce a wider variety of colors, the range available with the use of standard lamp colors is adequate for a majority of lighting needs.

The concept of coordinating lighting effects with music has been done many times in the past and with much greater finesse than that which has been attempted here. The attempt in this installation is simply to indicate some of a variety of possibilities.

Tape recording has been done in this auditorium and neither direct audio noise, nor direct or feed-back electrical noise is objectionable.

*The Superior Electric Co., New York, N. Y.

*Co-author.

Annual Index Available in January

The Index to 1961, to be published next month, will be mailed with the January issue of IE. As in the past, the Index will list articles published during the year by subject, title and author. The personnel section will be an alphabetical roster of all national and local officers and committee personnel.

The General Secretary Reports

By J. DIXON MITCHELL

In accordance with the By-laws of the Society, the General Secretary submits the following report for publication in Illuminating Engineering. Based on material recorded by Officers, Committees, Sections and Chapters, this report has been prepared with the assistance of the Managing Director, A. D. Hinckley, and other Staff members. Parts of the report were presented at the Society's Annual Meeting at the opening session of the National Technical Conference on September 25, 1961, in St. Louis.

MANAGEMENT

The Constitution of the Society delegates to the Council the responsibility for managing the affairs of the Society. During the past year this was done principally at the four regular meetings of the Council, and by the Executive Committee of Council at five interim meetings. At each meeting action was taken on routine matters, as well as the reports of committees, officers and staff members.

In a special two-day meeting in November, Council addressed discussion to the long range program in six areas —Financial Trends, Publications, Research, Public Relations, Membership and Regional matters.

Discussion of each of these subjects recurred during the year leading to such important actions as the approval of a major budget increase to implement the expanded program for ILLUMINATING ENGINEERING, the approval and implementation of the report of the Task Committee on Research Financing, and the inauguration of a professionally guided program of public relations.

The financial demands of the expanding program of Society services focused attention on the need for additional income, and led to extensive discussion of a constitutional amendment to increase individual membership dues. This proposal, originally submitted by the Advance Planning Committee and advocated by the Finance Committee, failed to get Council's approval.

Finances of the Society were heavily involved also in the meeting of expense incident to Headquarters move into the new United Engineering Center. Beyond this factor, much discussion was addressed to Staff plans for the office layout and equipment design.

As in previous years each session of Council and the Executive Committee devoted considerable time to discussion of the School Lighting Committee revision of the 1948 *American Standard Practice for School Lighting*. This culminated in Council's approval of the new *Guide for School Lighting* and the referral of this document for consideration by the Sectional Committee of the ASA.

Official action of approval was taken by Council on the following reports of Technical Committees:

Daylighting Committee—*Recommended Practice for Daylighting;*

1960-1961 IES Council in session.

Education Committee—*Lighting Fundamentals Course;*

Institutions Committee—*Church Lighting Report;*

Nomenclature Committee—*Proposed Section 60—Light & Vision Terms, Ultraviolet Radiation—Section 15—ASA Z7.1—Illuminating Engineering Nomenclature and Photometric Standards;*

Progress Committee—*Annual Report;*

School Lighting Committee—*Guide for School Lighting.*

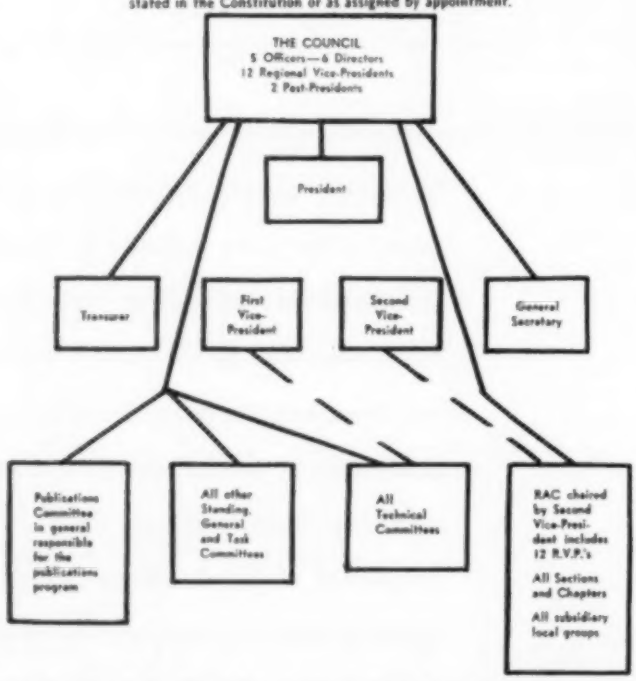
OFFICIAL AND HEADQUARTERS STAFF ORGANIZATIONS

Under the official organization, the affairs of the Society are managed by the Council subject to the Constitution (basic policy changeable only by the membership), and the By-laws (procedures set by the Council). This Council is composed of officers, directors, and the regional vice-presidents elected by the membership for their respective terms.

Between meetings of the Council, the

Figure 1.

The Official Organization of Illuminating Engineering Society showing lines of responsibility and accountability stated in the Constitution or as assigned by appointment.

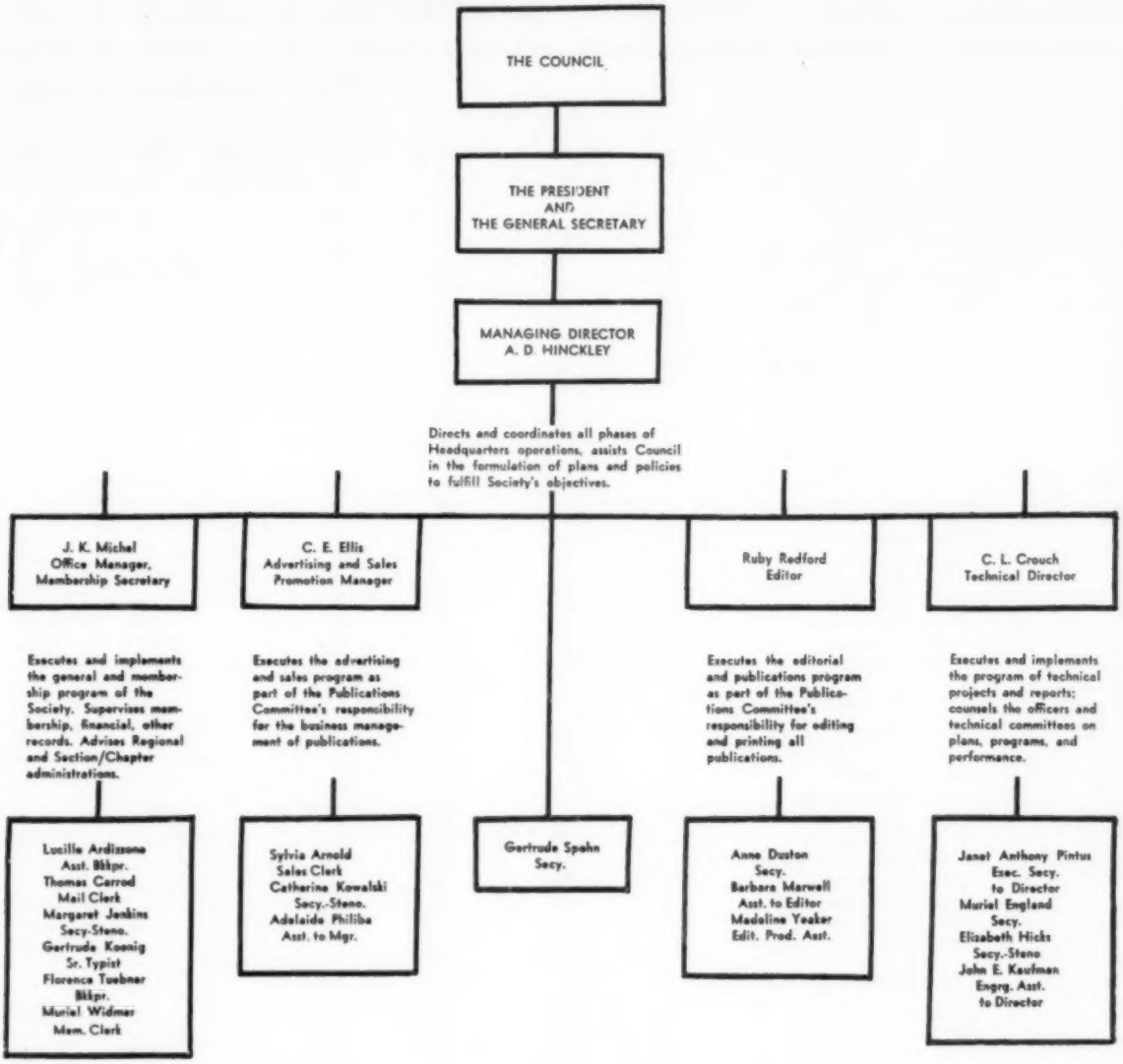


The President has general supervision of Society affairs under the direction of Council. The General Secretary is in general charge of Headquarters office and staff.
The Treasurer is responsible for liquid assets.

The President customarily assigns duties to the First Vice-President (general supervision of the Technical Committee program), to the Second Vice-President (general supervision of the Regional and Section/Chapter program).

Figure 2.

The Staff Organization at Illuminating Engineering Society Headquarters, showing lines of Responsibility


THE COUNCIL
THE PRESIDENT AND THE GENERAL SECRETARY
MANAGING DIRECTOR A. D. HINCKLEY
Directs and coordinates all phases of Headquarters operations, assists Council in the formulation of plans and policies to fulfill Society's objectives.
J. K. Michel Office Manager, Membership Secretary
C. E. Ellis Advertising and Sales Promotion Manager
Ruby Redford Editor
C. L. Crouch Technical Director
Executes and implements the general and membership program of the Society. Supervises membership, financial, other records. Advises Regional and Section/Chapter administrations.
Executes the advertising and sales program as part of the Publications Committee's responsibility for the business management of publications.
Executes the editorial and publications program as part of the Publications Committee's responsibility for editing and printing all publications.
Executes and implements the program of technical projects and reports; counsels the officers and technical committees on plans, programs, and performance.
Lucille Ardizzone Asst. Bkkpr.
Thomas Carrod Mail Clerk
Margaret Jenkins Secy-Steno.
Gertrude Koenig Sr. Typist
Florence Tuebner Bkkpr.
Muriel Widmer Mem. Clerk
Sylvia Arnold Sales Clerk
Catherine Kowalski Secy.-Steno.
Adelaide Philiba Asst. to Mgr.
Gertrude Spahn Secy.
Anne Duston Secy.
Barbara Marwell Asst. to Editor
Madeline Yeaker Edit. Prod. Asst.
Janet Anthony Pintus Exec. Secy. to Director
Muriel England Secy.
Elizabeth Hicks Secy.-Steno
John E. Kaufman Engrg. Asst. to Director

Executive Committee of the Council (the five officers) manages the affairs of the Society. The work of the Society is very largely carried out by its members who serve in elective positions, nationally and locally, and on the committees of the Society.

The chartered Sections and Chapters of the Society are principally concerned with the basic Society objective —the discussion of papers at their monthly meetings.

The whole official organization is held together through the lines of responsibility and accountability stated in the Constitution, or as assigned by appointment, (see Fig. 1). Lines and squares of an organizational chart, however, by no means portray the thousands of hours of effort and time contributed by over two thousand members in our official organization.

Commensurate with the growth of the Society, Council has authorized from time to time the development of a Headquarters Staff to assist the officers and committees, as provided for in the Constitution. As Headquarters takes up its new location in the UEC, it seems timely to review this organization of permanent staff members and their relation to the elected officers of the Society.

The staff groups, organized into departments (see Fig. 2) carry out their special functions on a full time, permanent basis. They are responsible for implementing and executing the actions and decisions of Council and the committees of the Society. From their experience and respective professional capacities, Headquarters Staff contin-

ually contribute suggestions, ideas, proposed courses of action and methods for solution of problems.

This "double" organizational structure must exist for orderly and effective control of the broad scope of the Society's activities and programs.

MEMBERSHIP

Statistics—Total membership of the Society continued to grow despite the usual losses due to resignations, dropped dues delinquents and deceased members. Table I records the membership by grade in the respective Sections and Chapters, as well as the non-Section membership. Fig. 3 shows the over-all membership growth, and reflects the total gains and losses indicated in Table II.

Fellow Emeritus, Fellows—The respec-

TABLE I—Membership of IES Sections

	Associate Members	Members	Students	Fellows	Members Emeritus	Fellows Emeritus	Total
CANADIAN REGION							
Bluenose Chapter	34	13					47
Forest City (London) Chapter	28	7					35
Golden West Chapter	32	6					38
Hamilton, Ont. Chapter	21	10					31
Maritime Chapter	16	4	1				21
Montreal Section	114	48					162
Northumberland Chapter	30	4					34
Ottawa Section	40	15					55
Quebec Chapter	40	8	7				55
St. Maurice Valley Chapter	19	6					25
Toronto Section	163	81		7	1		252
Winnipeg Chapter	49	9					57
EAST CENTRAL REGION							
Blue Ridge Chapter	20	6					26
Capital Section	61	48		8		1	118
Eastern Pennsylvania Section	77	39			1		117
Maryland Section	54	24			1		79
Philadelphia Section	235	85		4		1	325
Pittsburgh Section	125	69	1	3			198
Virginia Section	26	25			1		52
GREAT LAKES REGION							
Buckeye Chapter	61	19		2			82
Central New York Section	75	45		2			122
Cleveland Section	191	118	4	30	3	5	351
Kentuckiana Chapter	35	9			1		45
Miami Valley Section	62	14	1				77
Michigan Section	166	95	4	2	2	1	270
Northwestern Ohio Section	63	16	1				80
Ohio Valley Section	50	33					83
Rochester Section	92	22		1			115
Western Michigan Section	52	24					76
Western New York Section	85	17	2				104
INTERMOUNTAIN REGION							
Arizona Section	73	35					108
El Paso Chapter	13	8					21
New Mexico Chapter	36	5	1				42
Rocky Mountain Section	54	25		2			81
Southern Colorado Chapter	13	10					24
Utah Section	47	29					76
MIDWESTERN REGION							
Central Illinois Chapter	48	14					62
Central Kansas Chapter	30	7					37
Chicago Section	298	132		7	3	2	442
Cornhusker Section	69	13	1				83
Heart of America Section	59	32	11				102
Illini Chapter	30	12					42
Indiana Section	68	27	1		1		97
Iowa Section	58	25	4				87
Milwaukee Section	164	48	2	2			216
Ozark Chapter	17	20					37
St. Louis Section	142	42		4			188
Twin City Section	158	46		1			205
Twin Ports Chapter	36	5					41

tive Boards recommended and Council approved elections this year of three in Emeritus status, and eight in Fellow grade:

Emeritus

Gilson W. Beals—Fellow
Samuel G. Hibben—Fellow
Gwilym F. Prideaux—Fellow

Fellows

Herman E. D'Andrade
Grant E. Davidson
Arthur A. Eastman
George E. Inman
Merle S. Keck
Herbert A. Kliegl
Karl A. Staley
Arthur W. Weeks

Deceased—The Society records with sorrow the death of one Fellow, one MEMBER Emeritus, one MEMBER Retired, two Associates Retired, 18 MEMBERS and 39 Associate Members during the fiscal year:

Fellow—Pennow, Willis A.

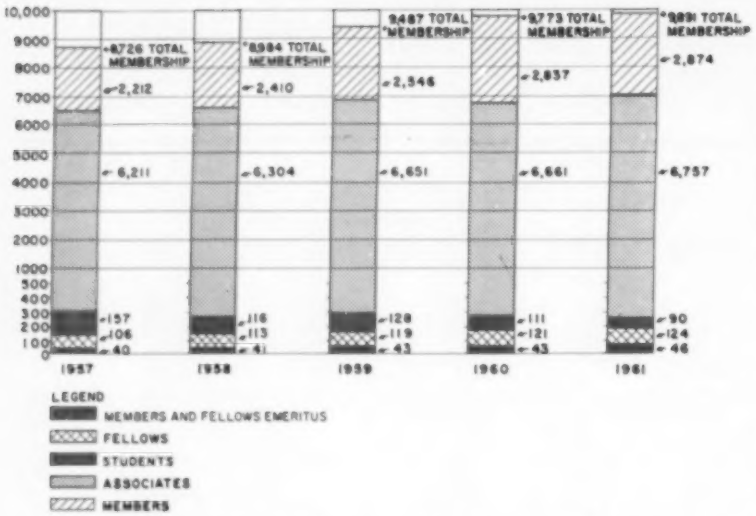
MEMBER Emeritus—Munroe, Charles C.

MEMBER Retired—Siedle, Raymond A.

and Chapters as of September 30, 1961

	Associate Members	Members	Students	Fellows	Members Emeritus	Fellows Emeritus	Total
NORTHEASTERN REGION							
Connecticut Section	106	29		1	1	1	138
Eastern New York Section	61	19		1	1		82
Housatonic Chapter	56	18	7		1		82
New England Section	218	100	1	8	2		329
New Jersey Section	143	83	1	8		1	236
New York Section	272	169	7	14	2	2	466
Yankee Section	39	21					60
PACIFIC NORTHWEST REGION							
British Columbia Section	67	27					94
Chinook Chapter	34	14					48
Edmonton Section	64	16					80
Inland Empire Chapter	47	17					64
Oregon Section	67	36			1		104
Puget Sound Section	71	39	1				111
Vancouver Island Chapter	19	3					22
SOUTH CENTRAL REGION							
Alabama Section	52	25					77
Arkansas Chapter	22	10					32
Gulf Coast Chapter	24	7					31
Mid-South Chapter	29	14	21				64
Mississippi Chapter	40	10					50
New Orleans Section	79	28					107
Tennessee Valley Section	33	29					62
SOUTHEASTERN REGION							
Central Florida Chapter	27	10					37
Coastal Empire Chapter	14	6					20
Florida Section	60	27			1	2	90
Georgia Section	92	65					157
Gulfstream Chapter	27	11					38
Palmetto Section	50	25	1	1			77
Southeast Florida Section	57	19	2				78
Suwannee River Chapter	17	13					30
Tar Heel Section	93	60		1			154
SOUTH PACIFIC COAST REGION							
Arrowhead Chapter	44	6					50
Diablo Section	82	22	1	1	1		107
Golden Gate Section	148	57	1	1			207
Mother Lode Section	45	21		1			67
San Diego Section	68	38			2		108
San Jose Chapter	52	10	2	1			65
Southern California Section	244	90	1	5	1	1	342
Yosemite Chapter	37	11					48
SOUTHWESTERN REGION							
Alamo Section	38	8		2			48
Ark-La-Tex Chapter	27	13					40
Central Oklahoma Chapter	29	17					46
Coastal Bend Chapter	18	10					28
North Texas Section	115	38	2	2			157
Oil Capital Section	42	22					64
Panhandle Chapter	14	2					16
San Jacinto Section	44	28					72
South Plains Chapter	21	7					28
Mexico Chapter	31	5	1				37
Non-Section	151	64		1	2		218
TOTAL	6,758	2,873	90	124	29	17	9,891

Figure 3.



Illuminating Engineering Society membership over past five years.

TABLE II—Gains and Losses in Membership During Year Ending September 30, 1961

	Members/ Fellows Emeritus	Fellows	MEMBERS	Associate Members	Student Members	Total
October 1, 1960	43	121	2,837	6,661	111	9,773
Gains						
Elections			89	1,040	41	1,170
Reinstatements			24	58	1	83
Transfers	4	8	115	4	1	132
Total Gains	4	8	228	1,102	43	1,385
Losses						
Resignations		1	124	477	60	662
Dropped			39	372		411
Deceased	1	1	19	41		62
Transfers		3	9	116	4	132
Total Losses	1	5	191	1,006	64	1,267
Net Change	3	3	37	96	—21	118
Total Membership as of September 30, 1961	46	124	2,874	6,757	90	9,891

Associates Retired—Goodwin, Harold, Jr., Taylor, Frank C.

Members

Beran, Willard J.
Bonny, Frank
Carpenter, Clyde O., Jr.
Davies, S. R.
Feige, Horst C. O.
Fisk, W. V.
Heckmann, L. F.
Johnson, Leon T.
Knox, Philip J.
Leopold, Charles S.
Morrison, Arthur W.
O'Donnell, John B.
Parish, William L.
Rainey, James G.
Smith, Franklin M.
Webb, D. Roland
Woody, Robert F.
Young, Philip

Associates

Benson, Lee H.
Blanco, Ricardo
Botvinick, Samuel
Burki, Edmund A.
Butler, J. V.
Bye, Harold G.
Connors, Raymond P.
Cornblatt, Sol J.
Davis, Creighton P.
Ng, Bong
Pederson, Clarence B.
Penney, Leo A.
Quisenberry, Herbert F.
Reeves, M. T.
Richardson, Robert
Roberts, William C.
Rogers, Anson H.
Roragaugh, William H.
Farrey, Vincent
Fremder, Adolph
Graham, William M.
Grim, Russell H.
Jones, Bradford
Keene, Charles C.
King, Clyde E.
Koslarek, Norman A.
Lucier, A. J.
Morse, Donald L.
Scribner, Roland D.
Shafer, W. A.
Shaw, Walter J.
Stanley, Robert W.
Tinstman, Elmer T.
Togesen, Alva A.
Vawter, B. Charles
Wilson, William L.
Wolf, Julian L.
Wolf, K. R.
Wolk, J. B.

REGIONAL ACTIVITIES

Committee Program—The twelve Regional Vice-Presidents and their Chairman, G. F. Dean, Vice-President, continued their usual very active program of service and assistance to the Sections and Chapters and to the regional operation. Four full-day meetings of the national committee were held in conjunction with the meetings of Council. At each of these a wide range of subjects and problems were discussed. At the local level key Section/Chapter officers and chairmen in each Region attended organizational meetings in connection with Regional Conferences, and in connection with the fall Regional Nominating Committee meetings.

Committee Study Projects—The committee gave active consideration to eight study projects of which four were completed during this year.

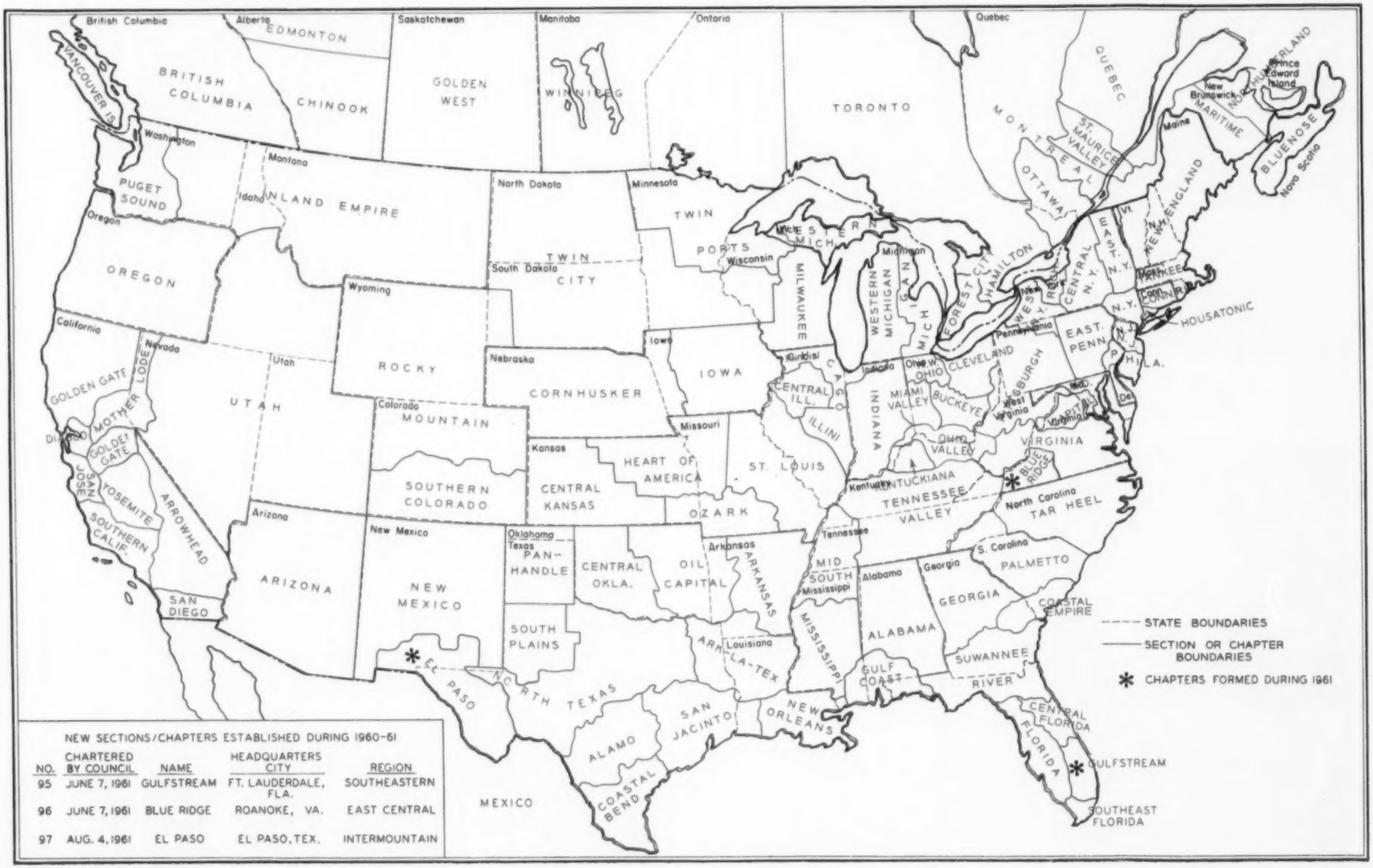
Project #3-59-60 Regional Vice-President's Manual of Guides—The Regional Vice-Presidents' Manual of Guides, prepared by John Michel of Headquarters, includes the edited and up-dated guides and instructions which have been distributed separately in previous years. The committee approved this Manual as the official Regional Vice-President Guide and considered this project completed.

Project #4-59-60 How to Conduct Section/Chapter Meetings—This supplement to the Section/Chapter Guide was prepared by John M. Chorlton. It outlines the proper organization and handling of Section/Chapter meetings. The committee accepted the project as complete and that it be included in the Section/Chapter Guide.

Project #8-59-60 Charter Night Declaration—Cecil Cannon submitted *The Suggested Procedure for Presenting Charter and/or Installation of Officers*. This study supplemented an earlier project called *Charter Night Procedure*. The committee accepted the final draft as a completed study project and recommended inclusion in both the Section/Chapter and Regional Vice-Presidents' Guides.

Project-Printing and Mailing Guide—A guide containing recommended methods of cutting costs in the printing and mailing done by Sections and Chapters was prepared by John Michel. The committee accepted this and recommended its inclusion in the Section/Chapter Guide.

Project #9-59-60 Residence Lighting Forum Financing—After careful study of the situation of Residence Lighting Forums by John M. Chorlton and Aileen Page, Chairman of the Residence Lighting Forums Commit-



NEW SECTIONS/CHAPTERS ESTABLISHED DURING 1960-61

NO.	CHARTERED BY COUNCIL	NAME	HEADQUARTERS CITY	REGION
95	JUNE 7, 1961	GULFSTREAM	FT. LAUDERDALE, FLA.	SOUTHEASTERN
96	JUNE 7, 1961	BLUE RIDGE	ROANOKE, VA.	EAST CENTRAL
97	AUG. 4, 1961	EL PASO	EL PASO, TEX.	INTERMOUNTAIN

Northeastern Regional Conference Committee meeting.

Section/Chapter officers meet in South Pacific Region.

tee, a project report by John M. Chorlton was submitted. The report included among its recommendations that: (1) future Forum financing be determined after study of a questionnaire survey; (2) Residence Lighting Forums to operate on a permanent basis as separate units of the Society organization; (3) establishment of uniform dues. This study will be continued in the 1961-62 fiscal year.

Project #1-60-61 Program Coordination, Project #2-60-61 Local Activities Committees, Project #3-60-61 Student Membership and Activity—These three projects were initiated, but not completed during 1960-61.

Section/Chapter Programs—The 97 Sections and Chapters (shown in the map on page 723) through more than 900 regular and special meetings continued to carry out programs of service through organization of their membership and committees.

New Chapters—The three new Chapters added to the Society during the year are shown on the accompanying map. Continued growth is indicated by the number of active groups looking toward Chapter Charters.

Slide/Lecture Service—Initiated, and largely administered by the Residence Lighting Forums Committee through John Michel at Headquarters, this activity is growing in popularity and in dimension. New lectures have been added and are available for Section/Chapter programs.

Regional Conferences—Nine Regional Conferences were held covering all the Regions except North Central and Midwest which were joint hosts to the National Technical Conference held in St. Louis.

East Central—April 10-11—Benjamin Franklin Hotel, Philadelphia, Penn., Chairman, Ralph R. Enghouser.

Southwestern—April 17-18—Oklahoma City, Okla., Chairman, Paul R. Sheline.

Southeastern-South Central—April 20-21—Biltmore Hotel, Atlanta, Ga., Chairman, Charles R. Minors.

Inter-Mountain—May 1-2—Salt Lake City, Utah, Chairman, Wayne F. Mulcock.

South Pacific Coast—May 4-5—Sacramento Inn, Sacramento, Calif., Chairman, Melvern P. Fenton.

Pacific Northwest—May 8—Harrison Hot Springs, Harrison, B. C., Chairman, E. A. Ernie Adams.

Canadian—May 15-16—Queen Elizabeth Hotel, Montreal, Que., Chairman, Jean Paul Cristel.

Northeastern—June 8-9—Berkeley Carteret Hotel, Asbury Park, N. J., Chairman, Bruce J. Jensen.

Great Lakes—June 19-20—Sheraton Gibson Hotel, Cincinnati, Ohio, Chairman, H. K. Flint.

HEADQUARTERS MOVE TO UNITED ENGINEERING CENTER

The move of Society Headquarters late in August this year from the New York, Columbus Circle, location to the new United Engineering Center on the United Nations Plaza has significance far beyond the physical transfer of Headquarters Staff and facilities. Under consideration since 1956, and actively discussed by Council since 1958, this move reassociates the Society with the major engineering Societies and professional organizations.

The facilities of the United Engineering Center building, and of the Society Headquarters are described completely in the October issue of ILLUMINATING ENGINEERING (pp. 588-594). The many services of the Engineering Societies Library and Engineering Index at the UEC are likewise well outlined in the October report.

The critical decision serving as background to the Headquarters move was made in 1958 when the Task Committee, headed by Past-President M. N. Waterman, studied all factors affecting the future location of Society Headquarters, and recommended that it remain in New York City. Although the Society had been invited to take space in the United Engineering Center, Council deferred a decision and after long discussions during 1958-59, acted in June that year to accept the invitation of the United Engineering Trustees. By this action the Society became an Associate in the United Engineering Center, participating in the benefits and assuming the obligations of the new Center on an equal basis with other Associate Societies.

As an Associate, the Society will continue to occupy space in the United Engineering Center as long as it complies with the provisions of an Associate Agreement and lease executed with the United Engineering Trustees. The basic provision calls for the Society to meet a pro-rata share of the building's operation costs. Secondary, but of considerable importance, is the Society's agreement to share in the maintenance of the Engineering Societies Library, and to continue to maintain its tax-exempt status as a scientific and educational organization. The Society will benefit from the fact that it has its

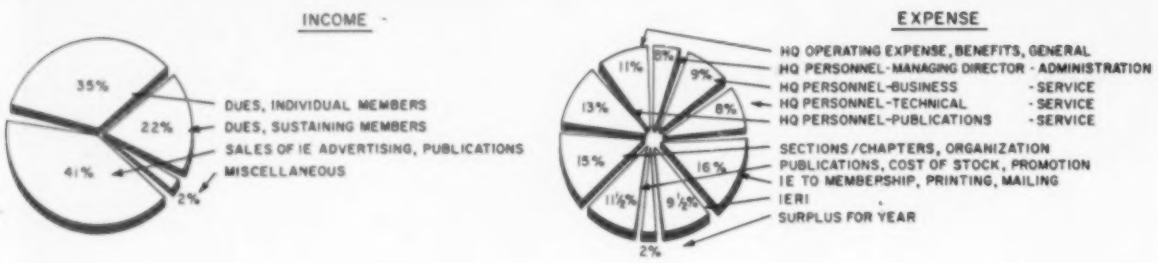
General office area in new IES headquarters in United Engineering Center. Floating panel, semi-indirect luminous ceiling system was designed to provide 200 footcandles. Note light-surfaced desks, floor, walls throughout.

Editorial department is typical perimeter office area lighted to over 100 footcandles from continuous rows of two-lamp four-foot troffers.

Managing Director's office with view of United Nations in background. Oiled walnut desk is topped with light beige working surface for maximum visual comfort.

Figure 4.

Percentage Distribution of Illuminating Engineering Society's Income and Expense



Headquarters in a tax-free, non-commercial building.

Together with the benefits inherent in the new location, the Society shares in the responsibility of building management. With the other Associates, the Society will be represented on the Building Operating Committee, and on the Library Board. The Operating Committee will recommend from time to time the assessment rates for space in the Center (covering operation, maintenance and depreciation reserve), and will also make recommendations as to regulations for building operation, services and facilities.

FINANCE

With A. C. Barr, Chairman, the Finance Committee continued the general supervision of the financial affairs of the Society. This included the preparation of a working budget for the fiscal year, and a periodic review of the financial operations as reported from month to month. The committee also reviewed for Council consideration the financial report of the 1960 National Technical Conference and a proposed budget for the 1961 Conference. As part of Council's review of a long-range Society program, the committee presented a study of financial trends over the recent years and into the current period. This report demonstrated the steady and solid growth of the Society, but also indicated the developing need for increased revenue to meet the expanding obligations in the research program and in the enlarged publications and public relations program.

The committee received periodic reports from the Advisory Custodian Service of the Irving Trust Company, and consulted with the company's rep-

Statement of Income and Expense for the Year Ending September 30, 1961.

INCOME		
Dues and Entrance Fees—Individual		
Fellows	$ 2,070.00	
Members	49,755.50	
Associates	98,748.64	
Students	436.25	
Entrance Fee	2,702.50	$153,712.89
Dues, Sustaining Members		98,180.00
Sales of Publications (gross)	63,435.27	
IE Advertising	119,369.77	182,805.04
Badges and Certificates (net)	301.18	
National Technical Conference (net)	1,346.91	
Sundry	228.27	1,876.36
Investments (reserve fund)		6,917.94
Sale of Furniture and Fixtures		2,762.95
TOTAL INCOME		$446,255.18
EXPENSES		
General (legal, dues, medal, audit, insurance)		4,115.33
Headquarters Expense (cleaning, rent, stationery, service, electricity, miscellaneous supplies, furniture and fixtures)		34,203.62
Headquarters Personnel (salaries, tel. & tel., postage, travel)		
Managing Director	21,138.30	
Business	40,063.27	
Technical	35,384.78	
Publications	57,388.44	153,974.79
Organization (Sections/Chapters, President, Regional Vice-Presidents, Council)		66,738.69
Headquarters Benefits (social security, pension, state disability)		11,421.93
IE Advertising Promotion		6,007.35
Publications, Stock, service		42,254.73
IE to Membership (printing, mailing)		72,760.14
Illuminating Engineering Research Institute		41,770.59
TOTAL EXPENSES		433,247.17
Excess of Income over Expenses		13,008.01
Special Activity		
IES Lighting Handbook, 3rd Edition		
Income: Sales	13,760.24	
Cost of Sales (promotion and selling Expense)	11,644.00	2,116.24
BALANCE OF INCOME TRANSFERRED TO GENERAL FUND SURPLUS		15,124.25

Comparative Balance Sheet as of September 30, 1961 and September 30, 1960

ASSETS		September 30 1961		September 30 1960
General Fund				
Cash in Bank and Office		$ 32,665.34		$ 15,873.36
Accounts Receivable		30,412.17		18,278.13
Inventories		8,940.44		15,894.32
Furniture and Fixtures (nominal value)		1.00		1.00
Deferred charges:				
Stock of Paper (IE Production)		5,513.35		9,112.32
Prepaid Expenses:				
Travel Advances: Headquarters Staff		1,925.00		1,925.00
(a) Due from Reserve Fund		18,094.53		
TOTAL GENERAL FUND ASSETS		$ 97,551.83		$ 61,084.13
Reserve Fund				
Cash in Banks		10,891.53		7,049.45
(b) Marketable Securities, at cost				
Bonds	32,744.39		43,056.89	
Preferred Stocks	60,065.00		60,065.00	
Common Stocks	70,185.11	162,994.50	70,157.66	173,279.55
TOTAL RESERVE FUND ASSETS		$173,886.03		$180,329.00
TOTAL ASSETS		$271,437.86		$241,413.13

LIABILITIES, SURPLUS AND RESERVES		September 30 1961	September 30 1960
General Fund			
Liabilities			
Accounts Payable:			
Trustees, Pension Fund	3,216.71		
(c) Other	33,842.68	37,059.39	851.30
(d) Deferred Income: subscriptions		6,244.89	—
Surplus		54,247.55	60,232.83
TOTAL GENERAL FUND LIABILITIES AND SURPLUS		$ 97,551.83	$ 61,084.13
Reserve Fund			
(a) Due to General Fund	18,094.53		
Reserve Fund Balance	155,791.50	173,886.03	180,329.00
TOTAL LIABILITIES, SURPLUS & RESERVE		$271,437.86	$241,413.13

(a) By Council action up to $25,000 from Reserve toward expense—new Headquarters.
(b) Market Values—9/30/61—$173,257. 9/30/60—$164,937.
(c) Accounts payable—expense of new Headquarters furniture and fixtures.
(d) Procedure changed to allocate income in year where applicable.

resentative from time to time, on the reserve investment program.

The considerable expense involved in the move of Society Headquarters from the New York City, Columbus Circle, location to the United Engineering Center was analyzed most carefully as to its effect on the Society's finances. Based on this study the committee made its recommendations to Council resulting in authorization of withdrawal from reserve of the funds necessary to complete the move, including the purchase of furniture and fixtures. The action anticipated a withdrawal from reserve of about $25,000, approximately half of the total costs.

The fiscal statements for the year are as given in the report of the auditor, MacNicol, Johnson & Company. These include statements of income and expense for the fiscal year, and the balance sheet as of September 30, 1961.

PUBLICATIONS

Six meetings of the committee were held during the year to plan current and future publication programs.

Guided by the professional reader-preference survey reported last year, the committee recommended to Council that at least one issue of ILLUMINATING ENGINEERING be published in two parts. The objective in this was: (1) To permit earlier publication of Conference papers; (2) To provide space for additional pages of practical application articles with larger pictures, attractive layouts, and color.

With Council's approval, one two-part issue (March 1961) was published, and eleven regular issues of the Society's magazine. Part I of March consisted entirely of "application" material, attractively presented. This part also contained such departments as "Lighting News," etc., and all of the advertising. Part II published, all at once, 96 pages of Conference papers and discussion. The two parts comprised a single issue of ILLUMINATING ENGINEERING and were received by all members and subscribers.

This innovation in the publication program has resulted in some 23 per cent increase of application articles over last year, and a better balance between technical and application material. It is believed that the increased proportion of application articles, coupled with functional and decorative use of color, has made the magazine more appealing to many of its readers.

Advertising

Effective with the January 1961 issue, advertising rates for ILLUMINATING ENGINEERING were raised by 14 per cent, the first increase in four years. This increase was well justified because during those four years, circulation had increased by better than 14 per cent, and many improvements benefiting the readers and the advertisers had been incorporated in our monthly publication. Also, due to paper, postage and other increases, production costs have increased considerably during the same period. In the face of advertising losses generally throughout the industrial press, IE's advertising has equalled 1959-60 in number of pages and, due to the rate increase, has earned considerably more in advertising revenue than in the previous year.

Publications Sales

The Publications Sales program was exceptionally successful during 1960-61, due to several outstanding new report reprints being published and their immediate and widespread acceptance by lighting people. *Lighting Keyed to Today's Homes*, published in February, 1961 was an outstanding success with 13,000 copies sold this year. Other popular reports this year were *Office Lighting, Sports Lighting, Lighting for*

TABLE III—Page Content of Illuminating Engineering October 1960-September 1961

	Number of Pages Published
Conference Papers, Discussion and Abstracts	318
Technical Committee Reports	142
President's, Vice-President's and General Secretary's Reports	19
Other Technical Articles	18
Application Articles	216
Data Sheets	29
Lighting News	131
Editorials	7
Committee Personnel, Officers, Sustaining Members	30
Advertising	423
Total Pages	1333

Outdoor Parking Areas, and *Airport Service Area Lighting*, all with the new pictorial covers which make them more attractive for distribution. These special covers are a feature which was started this year.

Society publications listing new recommended levels of illumination continue to be in demand. The latest version, a six- by nine-inch reprint of the complete Handbook section, replaces the original reprint of the same name *Recommended Levels of Illumination*. Over 70,000 copies of the first printing were distributed and nearly 20,000 of the new edition already have been distributed. Many electric utilities and others are having the cover imprinted for wide-spread distribution to educate others as to these new levels.

Nearly 1800 copies of the *IES Lighting Handbook*, Third Edition were sold during the year. A second printing with some minor corrections and updating is being planned for publication about March 1962. A new 144-page *IES Lighting Fundamentals Course*, fully illustrated and with a spiral binding, is now available and in stock and is being promoted for courses by Sections and Chapters.

ILLUMINATING ENGINEERING RESEARCH INSTITUTE

The complete 1961 report of the Trustees of the Illuminating Engineering Research Institute was not available at the time of publication. It will appear in an early issue.

STANDING COMMITTEES

Six standing committees are set up by Constitutional provision and reference has been made earlier in this report to the work of three of these, Council Executive, Finance and Publications. Reports for the remaining three follow:

Board of Fellows

B. J. Jensen, Chairman

The Board met on April 24, 1961 to consider nominations for transfer to the grade of Fellow. Each member was provided with information on all candidates prior to the Board meeting. This afforded ample opportunity for a thorough study of each candidate's qualifications. Eight nominations for the grade of Fellow were approved and recommended to Council for action at its June meeting, together with citations briefly describing the contributions of the nominees.

General Board of Examiners

Taylor M. Barr, Chairman

The Board held ten meetings at Headquarters for the approval of applications for election to MEMBER grade, or for transfer to Emeritus or Retired membership. The volume of applications was large, and the Board recommended favorable action to Council in 246 cases.

Papers

Benjamin S. Benson, Jr., Chairman

The Papers Committee received a total of 81 proposals for papers to be presented at the September National Technical Conference. Of this number, a total of 51 were tentatively approved. Upon reviewing the completed manuscripts, a total of 32 were selected for presentation. Two invited papers were added, as well as three IERI reports, to make a total of 37. It was again necessary to hold parallel sessions in order to accommodate all papers in the time available.

GENERAL AND TASK COMMITTEES

The General Committees of the Society are charged with the operating functions not handled by the Standing Committees, and not pertaining to the preparation of reports on scientific and engineering subjects. The work of the Regional Activities Committee has been given in the preliminary part of this report. Reports for the balance of the General and Task Committees follow:

Advance Planning

C. W. McCormick, Chairman

The committee studied and submitted recommendations to Council concerning several aspects of the Society's administration and program. The committee suggested more adequate preparation of Council for its sessions with ample time for discussion and deliberation. Recommendations were made relative to the term of office and service of Directors and Regional Vice-Presidents as members of Council.

Efficient use of budget allocations was urged by the committee in the area of staff travel to functions away from Headquarters, and in special surveys authorized by Council from time to time. Suggestions as to the Society's Public Relations and Information program were also submitted.

Consideration of the report was deferred pending scheduling at a Council meeting in the new fiscal year.

Allied Arts

Robert W. Brown, Chairman

Allied Arts competitions were held in fourteen schools of architecture in the United States and Canada. Students who participated were given abbreviated courses in illumination and personal critiques during the competitions. Problems in architectural design emphasized the importance of illumination as a design element.

Winning drawings in these local competitions were exhibited at the National Technical Conference in St. Louis and Award of Merit Certificates were

granted to students submitting the exhibited drawings.

As a result of a letter of invitation sent to all architectural schools in the United States and Canada, several additional universities have indicated their desire to participate in the competition in 1961-62.

Applied Lighting Competition

J. Carl Wilson, Chairman

Further steps were taken this year to strengthen the Applied Lighting Competition as one of the major activities of our Society.

Prize incentives were greatly increased at the Regional level, giving the winner a $75.00 first prize and a share in a $1,000.00 prize fund divided among the regional winners in accordance with the mileage from the Regional Conference city to the National Conference city.

The organization was much improved by the introduction of a simplified set of rules for the competitor, and complete instruction sheets for all levels of chairmen and judges. This made the competition much simpler to operate with much less correspondence and fewer questions.

During the year this committee was expanded with representation over the whole of the United States and Canada, and also a vice-chairman was appointed.

Board of Nomination

Kirk M. Reid, Chairman

The Board is comprised of three Past-Presidents of the Society, and one representative from each of the Regions, as prescribed in the Constitution. On February 8, 1961, the Board met and reviewed in depth the records of nominees proposed by the respective Regional Nominating Committees. From these many and able nominees, the Board prepared a nomination ticket covering the offices and directorships to be filled at the ensuring election.

Constitution and Procedures

L. C. Twichell, Chairman

The revision of the Society's *Manual of Procedures and Policies* to bring it into accord with the 1959 revision of the Constitution and By-laws, and with current practice, continued to be the principal project of the committee. The respective committees and officers concerned have cooperated in studies which will be reported to the committee when complete. The procedures under active study include those relative to the Technical Committee Program, the National Technical Conference and the Board of Nomination.

At the President's request the committee offered comment in a report to the September, 1960 Council meeting on the subjects of Joint Regional Conferences, Sustaining Members' dues, and Council letter ballot. No By-law or procedural amendments resulted from the committee's report.

Design Certification, Task Committee for Feasibility of

J. B. Browder, Chairman

Following study of the current position of the Society in this area, together with a review of the certification program during the years 1934-1944, the committee submitted several recommendations to Council. These were studied further by the committee, and in June, Council accepted the revised recommendations as follows: (1) the IES should develop recommended lighting performance criteria in various lighting fields, for the guidance of maker, specifier and user; (2) the IES should take no part in any product certification programs; (3) it is hoped that the availability of lighting performance criteria will lead manufacturers to have their product labeled as complying therewith when periodically checked and certified by an independent laboratory of recognized competence. There is a variety of ways in which this can be done; (4) it is suggested that initially, consideration be given to performance criteria in the office and school lighting fields.

To implement the foregoing report, Council acted to approve the appointment of a Task Committee to review what past work has been done by Society committees on the development of lighting performance criteria; to explore other areas, and to report to Council recommendations as to the method of implementing such criteria.

At the close of the fiscal year the appointment of the proposed Task Committee was turned over to the incoming administration.

Educational and Professional Standards, Task Committee on

C. L. Amick, Chairman

In September, 1960, President Slauer appointed a new Task Committee to study the trend in educational and professional standards for illuminating engineering, and to propose methods for their achievement.

In consultation with the Society's committees on Education, Membership, and Advance Planning, and the General Board of Examiners, the new Task Committee has selected several study projects for detailed exploration. These include the educational and professional requirements which might be appropriate for various grades of IES membership; the present and probable future status of State Registration as an "Illuminating Engineer;" the development of educational and professional standards which would be helpful to lamp and equipment manufacturers, distributors, contractors, utility companies, etc., in selecting candidates for lighting application or lighting "specialist" positions; and the outlining of required and optional courses in illuminating engineering at the university and trade school level.

The Task Committee also hopes to study the "public image" of engineering in general, and of illuminating engineering in particular. The ultimate goal of all the projects is to recommend activities, programs and policies which will increase the stature of people in lighting.

Historical

R. L. Zahour, Chairman

The committee was appointed late in the year and assigned the project of preparing a bound volume of historical records. This volume, which is to serve as a memorial to Past-President George H. Stickney, was still in the initial preparation stage at the end of the fiscal year.

IES Territorial and Organizational Task

J. R. Chambers, Chairman

This task committee's purpose was to study, at long range, the Society's regional structure and related organization. The first step was to study the present regional structure and similar geographical divisions of other engineering societies.

The September, 1960 meeting in Pittsburgh included a general discussion of the problems connected with this study. At the February meeting the committee recommended that John Michel, Office Manager at Headquarters, study the growth of Chapters and related problems.

The committee further recommended

TABLE IV—Regional Membership Campaign Winners

Region	Section/Chapter	Membership Chairman	Gross Increase Per Cent
Canadian	Winnipeg Chapter	V. S. Buckler	31
East Central	Philadelphia Section	George C. Linthicum G. Earl Watt	16
Great Lakes	Miami Valley Section	Jim Williams	33
Inter-Mountain	New Mexico Chapter	Olin Peddy	26
Midwest	Illini Chapter	Eleanor Duncan	42
Northeastern	Housatonic Chapter	Douglas A. Worth	32
North Central	Central Illinois Chapter	Robert John Tucker	21
Pacific Northwest	Inland Empire Chapter	George Romans	16
South Central	Mid South Chapter	Glen McMullen	30
Southeastern	Tar Heel Section	Harry Phillips	16
South Pacific Coast	Mother Lode Section	Clark Baker, Jr.	24
Southwestern	Central Oklahoma Chapter	Frank Rodesney	38

that the Regional Activities Committee analyze present Chapter characteristics such as activity, growth, development and problems of communication.

John Michel submitted a report to the Regional Activities Committee and the Council Executive Committee indicating the activity of Chapters during 1960-61 as well as the potential for development.

IES-USPHS, Joint Task Committee

J. F. Parsons, Chairman

The report of the Task Committee, *How to Make A Lighting Survey; A Vision Survey*, was accepted as a progress report by Council in 1955. Following a survey which indicated a sufficient demand to justify publication, the report was revised to bring it up to date technically. Publication in pamphlet form and, in part, in ILLUMINATING ENGINEERING is planned for the earlier part of 1962.

Lighting Service, Task Committee to Study

William P. Graham, Chairman

Following consideration of its initial report in the previous fiscal year, the committee restudied the matter, and resubmitted the original recommendations in a supplemental report. Final consideration remained incomplete at the close of the fiscal year.

Medal Award

A. F. Wakefield, Chairman

The committee held one meeting in New York City, and reviewed the qualifications of all candidates on file and newly submitted prior to January 1, 1961. A preliminary selection of the three best candidates was made, and following circulation of extensive biographical records, the full committee arrived at a selection of Deane B. Judd of Washington, D. C., to receive the 1961 Medal Award.

Membership

George W. Clark, Chairman

The membership campaign was organized principally through the activity of the committees in the 94 Sections and Chapters. In the Guide issued to each it was urged that local membership chairmen organize an active committee sufficient to reach prospects in all branches of the industry. Supplies and promotional folders were circulated from Headquarters. Each group was encouraged to develop contests and local prizes to stimulate action.

The national committee included regional chairmen in each of the twelve Regions. The national chairman issued monthly letters urging concentration on different segments of the prospective membership including electrical distributors, maintenance contractors, consulting engineers, electrical contractors and architects.

Headquarters assisted the national committee in mailing letters to two groups of prospects directly—the membership of the National Association of Lighting Maintenance Companies, and a part of the National Electrical Contractors Association membership.

The over-all result of the membership activity recorded gains of new members exceeding the members lost. The net gain for the year was less than gains achieved in recent years. Recognition was given to those Section/Chapter membership chairmen leading in the respective Regions. These are shown in the accompanying table.

National Technical Conference

C. L. Amick, Chairman

At the September, 1960 meeting of the committee in Pittsburgh, the New York Section invited the Society to hold its 1965 National Technical Conference at the Americana Hotel, to be built soon in Manhattan. The timing would also permit members and families to attend the 1964-1965 World's Fair in New York. The committee's recommendation to accept this invitation was approved by Council in February, 1961. Locations now scheduled for future Conferences are as follows: 1962, Dallas; 1963, Detroit; 1964, Miami Beach; 1965, New York City.

The committee has under consideration invitations from other Sections and Chapters, and any local group wishing to be the host at some future time should contact the chairman of the National Technical Conference Committee.

Public Relations and Information

Gordon Wells, Chairman

To implement the objectives of the Society through a public relations program, the committee, after considerable study, recommended that a professional public relations counsel be retained to develop a program. The committee selected Raymond C. Mayer & Associates, Inc., New York, to draft a Public Relations program for the Society.

The Public Relations and Information Committee, along with R. C. Mayer & Associates prepared a proposed public relations program on a national scale which included thirteen major projects. Council reviewed and approved this detailed program, and R. C. Mayer & Associates, Inc. was selected as Public Relations Counsel for the Society to put it into operation.

The program got under way after Council approval in June. To date, the following public relations projects have been completed, or are underway: a brochure on IES (*The IES Story*); a Public Relations Manual to aid local Sections and Chapters; twenty digest or news stories on the technical papers delivered at the National Technical Conference in St. Louis; a review of the Applied Lighting Competition;

UEC Inter-Society Cooperation; releases on election of officers and Fellows; preparation of feature stories on lighting standards; attendance at Regional and Sectional meetings. A Public Relations workshop of Section/Chapter Public Relations and Information Committee chairmen was held in St. Louis at the National Technical Conference.

Residence Lighting Forums

Aileen M. Page, Chairman

The principle objectives this year have been: (1) to stimulate interest in the formation of new Forums; (2) to develop materials to assist Forum officers in gaining an understanding of Forum operation and an acquaintance with the materials available to help meet Forum objectives. This year, seven new Forums were organized:

Forum	Sponsoring Section or Chapter
Denver	Rocky Mountain
Arkansas	Arkansas
Manitoba	Winnipeg
Niagara	Hamilton
Regina	Golden West
Parkland (Yorkton)	Golden West
Southwest (Swift Current)	Golden West

Membership, meeting and attendance figures for Residence Lighting Forums for 1960-61 are shown in Table V.

TABLE V—Residence Lighting Forum Activity

Forum	Membership	Meetings	Attendance
Arizona	74	5	200
Arkansas*	53	1	No Report
Atlanta	90	5	219
Capital	No Report—Inactive		
Chicago	34	3	352
Coastal Bend	39	9	247
Dallas	110	5	194
Denver*	45	5	180
Detroit	130	6	530
Hillcrest	26	2	34
Kansas City	68	5	109
Manitoba*	29	0	
New Jersey	89	5	362
New York	114	5	109
Niagara	33	0	
Regina	18	0	
St. Louis	42	4	85
Toronto	60	3	97
Twin City	87	6	207
Utah	No Report—Inactive		
Totals	1141	72	3225

*Organized after February, 1961

In addition to regular meetings the following special activities were carried on by a number of Forums:

Detroit—Conducted an all-afternoon and evening Residence Lighting Workshop to which architects and decorators were invited. Afternoon attendance, 51; evening, 49. Also planned in cooperation with the Michigan Section was a "Garden Lighting Fair" at which some 75 pieces of lighting equipment were shown and demonstrated in an actual garden. Attendance was in excess of 200.

Kansas City—Members cooperated in demonstrating better residence lighting in a local "Home Show."
The Study Club, sponsored jointly by the Kansas City Residence Lighting Forum and the Electrical Association of Kansas City presented the 12-session Academy of Lighting Arts to 21 persons, of whom 16 expressed a desire to become members of the Forum.

Niagara and *Toronto*—Each of these Forums arranged a one-day trip to Nela Park for their members.

Several Forums arranged inspection trips to well-lighted homes to view christmas lighting and to inspect television stations.

To meet its second objective the Committee is planning to supply to all Forums at the beginning of the 1961-62 year, notebooks for three officers in each Forum. These will contain such helpful material as mailing lists, report forms, suggested letters for membership campaign, meeting outlines, program ideas, and slides and literature available for Forum use. The notebook will be kept up to date by the National Committee and then will be passed on each year to the new officers.

First Officers of Denver Residence Lighting Forum.

Aviation Committee toured Andrews Air Force Base during spring meeting.

Sustaining Membership

George J. Taylor, Chairman

The principle effort of the committee was directed to an implementation of the June 1960 action of Council, approving that all increases in Sustaining Membership dues during 1960-61 be allocated to the IERI program. This campaign was undertaken anticipating Council's approval of the recommendation of the Task Committee on Research Financing that increased regular support of the research program be supplied principally from Sustaining Membership dues income. A special Sustaining Membership Fund Committee undertook to approach each Sustaining Member inviting increases in contributions bringing each dues amount in line with equitable formula figures. The efforts of the seven-man subcommittee were most successful resulting in approval by 181 Sustaining Members of dues increases totalling $37,684. With this outcome it was possible for the Society to meet its anticipated budget allocation to IERI for the forthcoming year.

The subcommittee made only moderate progress in the approach to new member prospects, and this part of the activity was passed along to the new administration. The committee, assisted by Headquarters, continued to keep Sustaining Members informed as to the Society's program, and concerning opportunities for more active participation in it.

The second annual luncheon honoring Sustaining Members was scheduled during the week of the National Technical Conference in St. Louis. Speaker at the luncheon was Harold Webster, President, National Electrical Contractors Association, Inc., whose topic was "Lighting Moves into High Gear—Light Up for Progress."

During each of the 1961 Regional Conferences, luncheons or other gatherings were arranged, bringing together the representatives of Sustaining Members for a report and greeting by the President.

The normal changes in membership resulting from business conditions and the efforts of local Sustaining Membership Committees, produced a final total of 475 Sustaining Members at the close of the year.

Tellers

Arthur H. Brooke, Chairman

As prescribed by the Society Constitution, the entire committee met on May 25, 1961 and certified the number of votes cast in each area for National and Section officers.

The Headquarters personnel, having done their usual excellent job of opening, collating and summarizing the ballots, the work of the committee in checking and verifying the results was comparatively easy.

Trustees—Headquarters Retirement Pension Plan

George J. Taylor, Chairman

The Trustees held their regular annual meeting at the time of the National Technical Conference in St. Louis, in September.

In addition to reviewing the operation of the Plan for the year, the Trustees reviewed studies carried on by Mr. Lowell relative to the financing of the Plan. On this basis the Trustees agreed to recommend consideration of the present plan (same eligibility and benefit provisions), but to investigate other funding methods which would provide existing benefits at less cost.

TECHNICAL COMMITTEES

Aviation

C. A. Douglas, Chairman

The Aviation Ground Lighting and the Aircraft Lighting Committee of the former Aviation and Signal Committee were combined this year to form the Aviation Committee. In addition, the practice of maintaining a committee structure of standing subcommittees has been discontinued. Instead, task groups are appointed as projects warranting their appointment develop. This change has led to increased activity in the sub-groups. The following task groups are now active:

Bibliography—W. C. Fisher, Chairman, is compiling and distributing abstracts of papers and reports pertinent to aviation lighting.

Hangar Lighting—Henry Wenson, Jr., Chairman, has started the preparation of a Recommended Practice for Hanger Lighting.

Heliport Lighting—V. E. Converso, Chairman, has completed a Recommended Practice for Heliport Lighting which is now being reviewed by the committee.

Lamps for Ground Lighting Service—F. E. Carlson, Chairman, is actively engaged in a study of the factors affecting the maintenance of the output of heavily loaded incandescent lamps.

Taxiway Lighting—L. W. Hornfeck, Chairman, is studying the operational requirements for taxiway lighting preparatory to the drafting of a Recommended Practice.

The fall Technical Conference of the committee, held in New York in December 1960, emphasized the international aspects of aviation. Six foreign and two U. S. members of the Visual Aids Panel of the International Civil Aviation Organization, which had just completed a three-week meeting in Montreal, attended and participated in the conference with three of the members presenting papers. In addition, there was a program of papers presented by members of the committee, including a report of aviation lighting in Russia, and of the Sixth Interna-

tional Lighthouse conference; and tours of the new Eastside Manhattan Heliport on its opening day, and the hangar and ramp areas at New York International Airport.

The committee's Spring Technical Conference was held in Washington in May. This conference featured technical papers on visibility and visual range, touchdown zone lighting, and recent developments in aircraft lighting. The committee also visited Andrews Air Force Base where they were briefed on the visual landing aids program of the Air Force and were shown the lighting installations on a recently completed runway both from the ground and from the air.

Color

R. C. Allison, Chairman

A *Recommended Treatise for a Guide on Color and the Use of Color by the Illuminating Engineer* was submitted by the committee to the Technical office for comments. The Technical office solicited comments from three prominent colorists and transmitted these to the committee together with its own comments. The committee has now prepared the report with revisions and additions and has submitted a complete work to Council.

Daylighting

J. W. Griffith, Chairman

The Daylighting Committee held one meeting this past year at the National Technical Conference, Pittsburgh, Pennsylvania.

The primary purpose of this committee for the past five years has been to revise the 1948 *Recommended Practice of Daylighting*. This year the committee submitted the Revised Recommended Practice to Council for approval and has answered all Council's questions regarding this revision.

Design Practice

Bill F. Jones, Chairman

The committee got under way with a reorganization of its activity in midyear. Possible projects were under consideration, including coefficient systems and the problem concerning maintenance factors.

Education

Alston Rodgers, Chairman

The long-awaited *Lighting Fundamentals Course* is now in publication and available for use by Sections and Chapters. This is a greatly expanded and improved booklet, published in attractive, spiral-binder form. It differs from former IES Lighting Course booklets in that it contains reference tables, charts and notes required to work out examples and problems. It is intended to be placed in the hands of students as well as instructors.

First draft of the *Advance Lighting Design Problems Course* is nearing completion and should be ready for review by the committee shortly.

Further revisions have been made in the manuscript of the proposed brochure for college students, *Careers in Lighting*. This will be submitted soon for Council consideration.

Farm Lighting

Morris H. Lloyd, Chairman

The committee has had the cooperation of Dr. H. R. Blackwell in the measurement of critical seeing tasks in barns. These results are serving as a basis for the committee's development of illumination recommendations.

Handbook

M. N. Waterman, Chairman

The committee submitted two reports to Council. These reports give recommendations regarding timing of decisions on reprinting the present third Edition of the Handbook and on revisions looking to a new Fourth Edition.

Industrial

L. G. Parks, Chairman

This committee consists of twelve members. In addition there are seven subcommittees. One subcommittee is working on a revision of the *American Standard Practice for Industrial Lighting;* five subcommittees are developing recommended lighting practice in the fields of men's clothing, graphic arts, outdoor productive areas, rubber industry and women's hosiery; the remaining subcommittee (woodworking) is inactive at present.

Committee activity during the past year included two meetings which were primarily devoted to the reports of subcommittees. Two reports were approved: men's clothing, and outdoor productive areas (Railroad Yards report). These reports will be presented to the September Council.

Progress continued on the proposed revision of the *American Standard Practice for Industrial Lighting* and it is planned for presentation in preliminary form to the ASA in December.

Institutions

R. D. Bradley, Chairman

The Church Lighting Subcommittee has completed its work. The complete volume, together with illustrative material, is now ready for final checking and approval, and it is expected it will be in print this year.

Upon the completion of this work, the Institutions Committee will have completed assignments on Hospital Lighting, Hotel and Dining Area Lighting and on Church Lighting.

Light Control and Equipment Design

J. N. Robertson, Chairman

The committee held three meetings plus several subcommittee meetings during the year. Work continued on the *IES Guide to Design of Light Control*.

Attention was concentrated on materials. Reports were completed on glass, plastic, aluminum, steel, fabrication of materials, and finishes.

The IES-SPI-NEMA Joint Plastics Subcommittee has been exploring means of establishing new criteria for accelerated aging and for discoloration of plastics. A new working committee was set up to prepare recommendations for performance characteristics of plastics.

Light Sources

H. A. Anderson, Chairman

Two committee meetings were held at IES Headquarters. Revisions and changes in light sources data are being submitted periodically for the *IES Lighting Handbook*.

A technical report has been completed on *Effect of Temperature on Fluorescent Lamps*. This work was accomplished by a special Task Committee which summarized the data and activities accumulated during the past several years. It is expected that this report will be published shortly.

Additional "Questions and Answers" are being submitted periodically for publication in ILLUMINATING ENGINEERING. Since this feature has such popular interest, it was decided to accelerate the number of questions and answers for publication next year.

Much work has been done by the Subcommittee on Color Rendition, Miss D. Nickerson, Chairman, in collabora-

tion with the CIE E-1.3.2. It is expected that this work will be completed and approved by both committees during this coming year.

Lighting and Air Conditioning

W. S. Fisher, Chairman

This committee held its inaugural meeting in May, 1961, at Nela Park. A detailed program of study was planned involving the analysis of lamps and lighting systems as heat sources, methods of controlling lighting heat, and integrated lighting-heating-cooling systems. Working assignments will be made soon.

Maintenance

Leo Duval, Chairman

During the year the committee was in the process of reorganization.

Merchandising

W. H. Kahler, Chairman

Two committee meetings were held to review manuscripts from the subcommittee on the *Store Lighting Guide*, and conduct other committee business.

The *Store Lighting Guide* is now nearing completion and should be available for presentation to Council early in the 1961-62 year. The subcommittee and the general Merchandising Committee have been striving to incorporate the basic "lighting for merchandising" techniques into the Guide in such a fashion that the material will be useful to both engineers and merchandisers, and will not become completely out-of-date with a few changes in architecture and selling "fads."

The Subcommittee for the Study of Statistical Results of Lighting on Merchandising under the chairmanship of C. W. Clarkson sent out 64 questionnaires to merchandising organizations, publications, large lamp manufacturers, government agencies and engineering groups requesting statistical data on the increased sales due to improved lighting.

Motor Vehicle (Exterior)

Ray P. Teele, Chairman

At the present time there is no standard practice in automotive signal lighting and the committee can prepare only a study report. The draft of such a report awaits final decisions by the Automobile Manufacturers Association on the "ground rules" it will adopt for signal systems. These decisions are now scheduled to be made by the AMA by October 1, 1961, and the IES draft of its study report will be completed after the AMA decisions are made known.

Nomenclature

Sylvester K. Guth, Chairman

Work on the revision of ASA Standard Z7.1, *Illuminating Engineering Nomenclature and Photometric Standards*, has progressed sufficiently to permit expressing the hope that the document will be completed in the not-too-distant future. Ten of the eleven sections have been approved by the committee. The remaining one—Section 40, Lighting Calculations—is currently being reviewed.

The main remaining task is to complete the rearrangement of Z7.1 to bring it into conformity with current ASA practice. This is currently underway.

Office

Gene G. Rae, Chairman

Several matters involving the new Recommended Practice were discussed in consultation with committee members during the year. No formal activities were conducted since it was felt that sufficient time should elapse after the publication of the current Recommended Practice to determine the degree of its acceptance and utility by professional and lay people.

Progress

M. K. Strang, Chairman

The Committee maintained contact with the lighting advances throughout the world and prepared the yearly review of the achievements in the art of lighting for publication in ILLUMINATING ENGINEERING. This review was given a dramatic presentation as one of the features of the 1961 National Technical Conference in St. Louis. The Committee presented the 1960 review to over 2,000 people at various Region, Section and Chapter meetings.

Quality and Quantity of Illumination, Recommendations for

John J. Neidhart, Chairman

The committee acted on several specific items in addition to continuing its program to develop methods of evaluating or predetermining lighting quality factors. In one of these actions the committee reviewed the scissors curve and prepared a statement indicating that the committee sees no reason for objection to application committee use of the scissors curve and the accompanying limits on maximum to average brightness ratios if the assumed applicable conditions and arbitrary aspects are clearly stated, and if examples of situations are mentioned wherein the scissors curve might not apply completely on a go—no-go basis.

In response to a request from the Aviation Committee for assistance in determining recommended levels for emergency lighting of aircraft cabins, the committee recommended to Council that an emergency lighting committee be formed to study the requirements.

At the request of the Council Executive, this committee reviewed a Residential Lighting Committee proposal to change the recommended illumination levels for homes to average instead of minimum on the task. The committee reaffirmed its initial recommendation that all illumination levels be minimum on the task.

Residence

S. R. Shemitz, Chairman

A program was initiated to investigate mood and atmosphere in lighting, to continue this coming year.

Recommendations were made for the revising of judging of Applied Lighting Competition entries in Class I.

Roadway

Thomas J. Seburn, Chairman

The major objective of the Roadway Lighting Committee during the past year has been to attempt to complete its recommended revision of the *American Standard Practice for Roadway Lighting*. The prime consideration of the committee has been the work of its Subcommittee on American Standard Practice, as well as that of the Research Subcommittee, the Committee on Roadway Lighting Principles, and the Committee on Traffic Safety, which contribute most directly to this project.

In preparing its report the lighting intensities proposed by the Subcommittee on American Standard Practice have been based primarily upon studies conducted by Dr. H. Richard Blackwell and previously reported to the committee at its meeting in June, 1960.

At a two-day meeting in Atlanta, Georgia this spring the committee considered the proposal of the Subcommittee on American Standard Practice, and after numerous amendments accepted the report. These amendments are now being incorporated in a draft

that will be submitted to the entire committee for letter ballot. Based upon results obtained from this letter ballot decisions will be made as to the next steps to be taken.

School

J. M. Chorlton, Chairman

Final revision of the 1948 *American Recommended Practice for School Lighting* was completed by the committee during the year and approved. The report was presented to Council at its June meeting and subsequently approved by letter ballot. It is expected that processing through the American Standards Association as an American Practice will proceed quickly and an early meeting of the ASA Section Committee A-23 is expected.

The committee has been instructed by Council to prepare a presentation containing photographs and other additional information.

Searchlight

T. I. Monahan, Chairman

The committee reported no activity during the fiscal year.

Sports and Recreational Areas

Wallace W. Weld, Chairman

During the past year the Sports Lighting Committee has carried out further studies in regard to drag strips, go-kart racing, and trap layouts.

The committee also took under consideration the use of new quartz iodine lamps on some of the recommended layouts. It was agreed that the pole locations as shown in the recommended layouts should not be changed, as they are required for good over-all lighting.

Further studies are to be made on all above mentioned areas, and several subcommittees have been appointed to carry this work forward.

Testing Procedures for Illumination Characteristics

Arthur W. Weeks, Chairman

Two meetings were held this year, each of which required two full days. The committee has thirty-three full members, and one honorary member. The participation of two members from Canada is particularly welcome.

The *Guide for the Measurement of Photometric Brightness*, under the chairmanship of P. H. Lamson, was completed and approved by Council. Chairman Priscilla Presbrey, and her subcommittee, have completed the *Guide for Methods and Techniques of Measuring and Reporting Tests of Reflector-Type Lamps*. This Guide has been submitted to the Testing Procedures Committee for letter ballot.

The committee has fifteen guides in process. Of these, five are well along toward completion, three deal with existing Guides, which have been reactivated because of changes in product or testing techniques. Three are completely new responsibilities.

There are five study projects under consideration. Three of these will probably be elevated to the status of Guides and two are new projects.

Aerial view of United Engineering Center, (indicated by arrow). United Nations Secretariat and General Assembly buildings are in left foreground.

Theatre-Television

Joel E. Rubin, Chairman

The committee reports the following accomplishments during 1960-61:

(1) *The Recommended Practice for Reporting Photometric Performance of Incandescent Filament Lighting Units Used in Theatre and Television Production:* The Practice was adopted by the American Educational Theatre Association, and is being considered for adoption by the United States Institute for Theatre Technology. Two hundred copies of the Practice were made available for distribution at the London Conference, June, 1961, of the International Association of Theatre Technicians. Additional copies have been made available for study by the various centers of committee 3.1.9.2 of CIE.

(2) *Lighting for Vidicon Camera Installations:* The report, backed by over two years of research, is now in semi-final draft stages, and includes many photographs taken especially for the report on in-service vidicon camera installations.

(3) *Lighting for Educational and Community Theatre Stages:* Aimed at meeting the needs of architects and engineers as well as the actual user group, this report is now in the semi-final draft.

(4) *Dimming Device Calibration:* A paper on a proposed system for calibration of dimming devices intended for theatrical and television applications is in process of preparation.

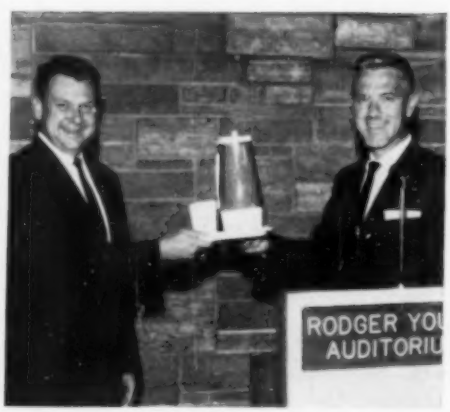
(5) *Light Sources:* A series of study papers dealing with potential new light sources for theatre and television applications is being undertaken by the committee as one of the new projects for the 1961-62 work year.

(6) *Inter-Society Liaison:* This has been established on the committee level during the past year with the American Educational Theatre Association and the United States Institute for Theatre Technology. Past relations with the Society of Motion Picture and Television Engineers have been sustained.

Here and There With IES Members

Transfer of power. South Pacific Coast Regional Vice-President, Roy Kreyser (right in photo above), presents certificate of appreciation to retiring Golden Gate Section chairman, Frank Duhme, and (photo at right) gavel of office to incoming chairman, Arthur Tylor. Viewing the gavel presentation, l. to r.: R. L. Sawyier, vice-chairman; Walter Bayha, board of managers; Glenn Smith, secretary. Photo: W. A. Cyr, *Electrical West*.

Guiding Montreal Section for 1961-1962 IES year will be, left to right, front row: W. J. McCormick, secretary-treasurer; W. G. Moore, chairman; J. H. Beaudet, program; (back row) H. Z. Goldstein, public relations; G. E. Mean, internal relations; A. Dandenault, program; P. Aerts, education.



Joint meeting of Arrowhead Chapter and Southern California Section featured talk by W. S. Fisher (standing right in photo at left), General Electric Co., Nela Park. Shown here introducing Mr. Fisher is Arrowhead program chairman, Jerry Silvers. At left is J. Roy Jones, Southern California chairman; at right, Stan Mallory, Arrowhead vice-chairman. In photo at right, new Arrowhead member, Frank McClintok (right) receives attendance award from Dr. Harry Jolliffe. Chapter awards a prize at each meeting to spur attendance.

LIGHTING NEWS

UNITED ENGINEERING CENTER DEDICATED

An event of historic importance for the engineering profession was celebrated November 9, 1961. This was the formal dedication of the United Engineering Center, the imposing new structure on United Nations Plaza, New York City, which now houses 19 engineering organizations (including IES). Taking part in the ceremonies were some 700 engineers and guests assembled in the building's auditorium and Exhibition Hall. Special press rooms enabled the nation's press representatives to view the event on closed-circuit television.

Honorary chairman of the dedication was former President of the United States, the Honorable Herbert Hoover. Mr. Hoover had also officiated at the UEC ground-breaking ceremony in October, 1959, and at the laying of the cornerstone in June 1960. For the record, the complete text of his remarks at the dedication is given in the box on the following page.

Participating with Mr. Hoover were other distinguished speakers and guests, among them His Eminence Francis Cardinal Spellman, the Honorable Robert F. Wagner, Mayor of New York City, and Dr. Eric A. Walker, President of Pennsylvania State University who delivered the Dedication Address. Representing the generation of future engineers on the program was William Hallerberg, an honor engineering student from Missouri School of Mines and Metallurgy, Rolla, Mo. In his student address, Mr. Hallerberg said in part, "My role here . . . is somewhat different from that of the other speakers. All these distinguished gentlemen and most of you in the audience are the people responsible for this impressive building. You are the ones who first conceived the idea . . . I on the other hand am a member of, and represent the generation of engineers . . . who will surely benefit most from its existence . . . every member of your generation responsible for these accomplishments (in engineering), especially this building, is proud that he has built for the future . . . every member of my generation is grateful for what has been done for us."

The ceremonies commenced with the national anthem played by the 579th Air Force Band, and an invocation delivered by Rabbi Arthur T. Buch, Congregation Shaare Zedek. Francis Cardinal Spell-

Willis F. Thompson, president of United Engineering Trustees, Inc., was chairman of the dedication ceremonies.

Robert F. Wagner, Jr., Mayor of the City of New York, presented UEC with a key to the city.

DEDICATION ceremonies at United Engineering Center, new home of IES and 19 other engineering groups. In photo at left, Francis Cardinal Spellman, Archbishop of New York, is shown delivering special dedication prayer.

Highlight of ceremonies was presentation of Hoover Engineering Medal to Dr. Mervin J. Kelly (left in photo at right), shown here being congratulated by President Hoover. At right, IES President James R. Chambers.

man of the New York Catholic Diocese led a special prayer for the new building and the closing benediction was offered by Dr. Dan Potter, executive director of the Protestant Council of the City of New York.

The complete program of this impressive dedication is given below.

DEDICATION PROGRAM

Chairman—Willis F. Thompson, President, United Engineering Trustees, Inc.
National Anthem—579th Air Force Band, Stewart Air Force Base, Newburgh, N. Y.
Invocation—Rabbi Arthur T. Buch, Congregation Shaare Zedek, New York, N. Y.
Introductory Remarks—Mr. Thompson.
Address by Honorary Chairman—The Honorable Herbert Hoover.
Prayer—His Eminence, Francis Cardinal Spellman.
Greetings from President John F. Kennedy—presented by Walter Whitman, Science Advisor to the Secretary of State, United States of America.
Greetings from Governor Nelson Rockefeller—presented by Peter Paul Miller, head of the New York City Office of the State of New York.
Congratulatory Message—The Honorable Robert F. Wagner, Mayor, City of New York.
Presentation of Hoover Medal—to Dr. Mervin J. Kelly by Walker L. Cisler and Mr. Hoover.
Student Address—William L. Hallerberg, Senior Student, Missouri School of Mines and Metallurgy, Rolla, Mo.
Dedication Address—Dr. Eric A. Walker, President, Pennsylvania State University.
Benediction—Dr. Dan Potter, Executive Director, the Protestant Council of the City of New York.

REMARKS BY HERBERT HOOVER

United Engineering Center Dedication New York City, November 9, 1961

This is a day of rejoicing among the 300,000 engineers in the United States. We have dreamed of this building for many years. We have believed that by housing our nineteen different societies under one roof we would have more unity of purpose in our professions. We have believed that by housing our 19 different societies under one roof hope that fallout of brevity, unity and constructive action streaming American people.

We did not deliberately erect this twenty-storied structure in order to keep an eye on the United Nations across the street. But we may hope that fallout of brevity, unity and constructive action streaming from these rooms might penetrate into their assemblies.

On our side of the street engineers do not need shelter from the radiations of Karl Marx of certain segments of the United Nations.

Our engineering professions have two major responsibilities to the American people

It is our duty to take the discoveries in science from over all the world and translate them into new inventions, new processes and new facilities which will keep the American standard of living ahead of all the world. We have long since proved that our nation has the creative genius to do it. The exchange of ideas facilitated by this Engineering Center will give even more assurance of this service.

We also have a responsibility to see that we maintain the supply of trained scientists and engineers needed by our growing economy and our national defense. I regret to say that we have fallen behind the Communists in this field. But with this new united front we can provide the remedy.

I should at once pay tribute to the Joint Committee of the Engineering Societies who have raised some $20,000,000 from our own members and their employers. They have sought no government aid.

It is indeed a great honor which my fellow engineers have bestowed upon me by their request that I should preside at this dedication. Once an engineer you are always an engineer at heart—notwithstanding any temporary departure into other fields of service—for it is the most constructive profession in the world.

It is my great privilege on behalf of the engineers of the United States now to dedicate this building to the services of mankind.

May the blessings of the Almighty rest upon you.

Hoover Medal Presented to Dr. Mervin J. Kelly

Dr. Mervin J. Kelly, former chairman of the board of Bell Telephone Laboratories, Inc., was awarded the 1961 Hoover Medal for "distinguished public service," during ceremonies marking the dedication of the new United Engineering Center (see page 9A). The Medal, established in 1930 by the American Society of Civil Engineers, American Institute of Mining, Metallurgical and Petroleum Engineers, American Society of Mechanical Engineers and American Institute of Electrical Engineers, was presented to Dr. Kelly by former President Herbert Hoover, for whom it is named.

The citation accompanying the medal honored Dr. Kelly's achievements as an "Engineer, scientist, distinguished leader in industrial and military research whose dedicated efforts and engineering skill have contributed to greatly improved communications; who has furthered the cause of engineering service to mankind through inspired leadership in creation of a great United Engineering Center."

After receiving his Ph.D. in physics from the University of Chicago in 1918, Dr. Kelly joined the Western Electric Co. as a research physicist. His work for the first ten years was in the areas of thermionic emission, gaseous discharge phenomena and electron dynamics. In 1928 he began to work on the applications of acoustics in telephony; was appointed development director of transmission instruments and electronics at Bell Telephone Laboratories in 1934 and director of research in 1936. In 1951 Dr. Kelly was elected as president of the Laboratories, and became chairman of board in 1959, shortly before he retired.

The Hoover Medal is one of many honors he has received for his achievements and public service activities.

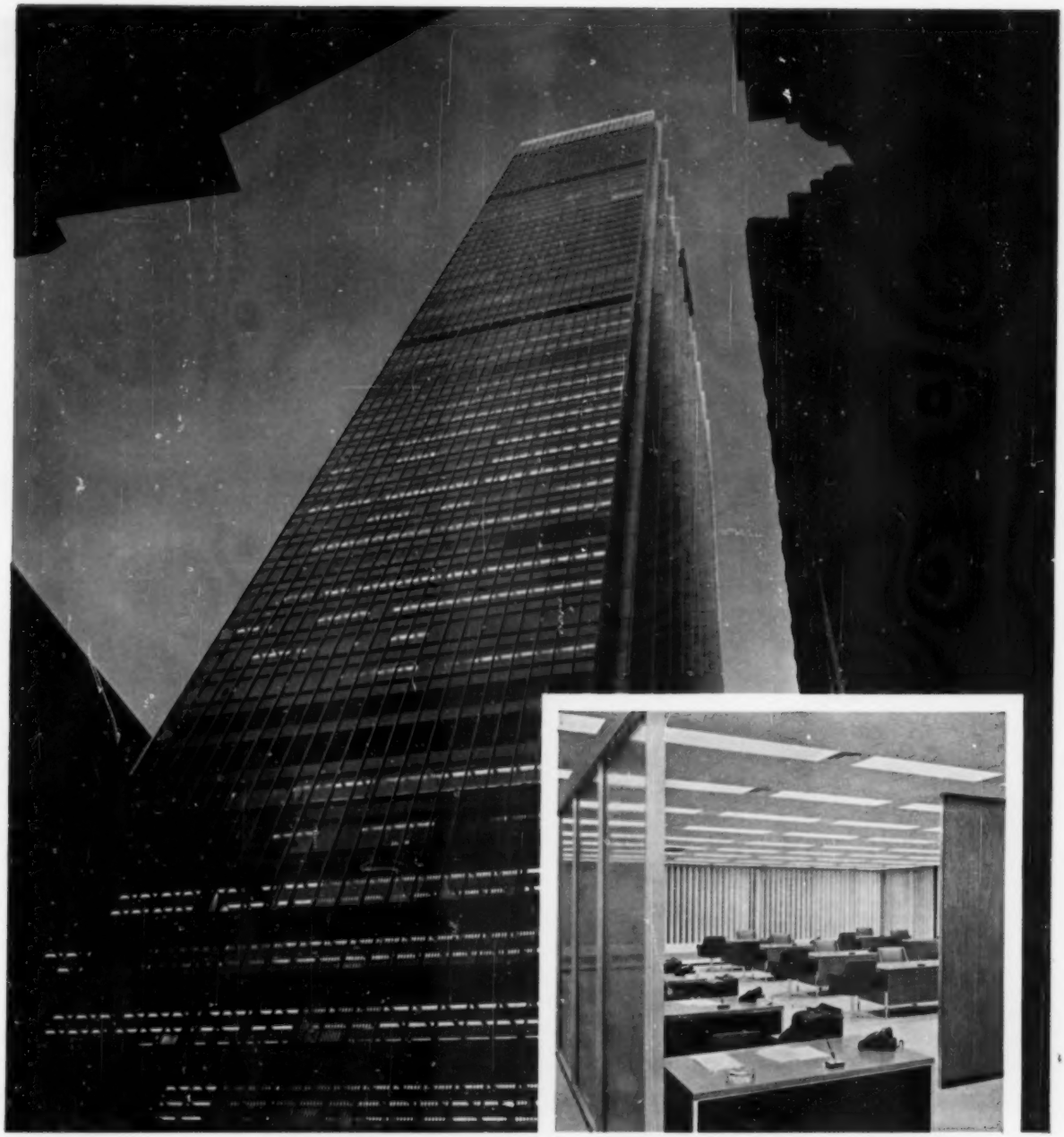
Expansion Considered for RLM Certification

At its annual meeting held in Cleveland on October 25, the RLM Standards Institute, Inc., reported a projected plan to expand the RLM certification and label service into all fields of lighting. Presently the certification applies only to industrial fixtures.

Following the recommendations of the Institute's long-range planning committee, the board of trustees has instructed the RLM technical committee to prepare a new series of RLM Standard specifications for basic commercial and school lighting fixtures. The new specifications will be submitted to the Institute's membership for approval early in 1962. Following approval of the specifications, fixtures of member manufacturers which comply with the standards will carry the RLM label.

The decision to expand the certification program was based upon an independent survey of the lighting fixture industry, prepared by Jack E. Mildner,

(Continued on page 14A)



Architects: Skidmore, Owings & Merrill

Lighting for prestige buildings— Plexiglas

There are 40,000 fluorescent luminaires, each equipped with a lens molded of crystal-clear PLEXIGLAS® acrylic plastic, at the new Chase Manhattan Bank building in New York—a landmark on the downtown skyline and a milestone in architectural planning.

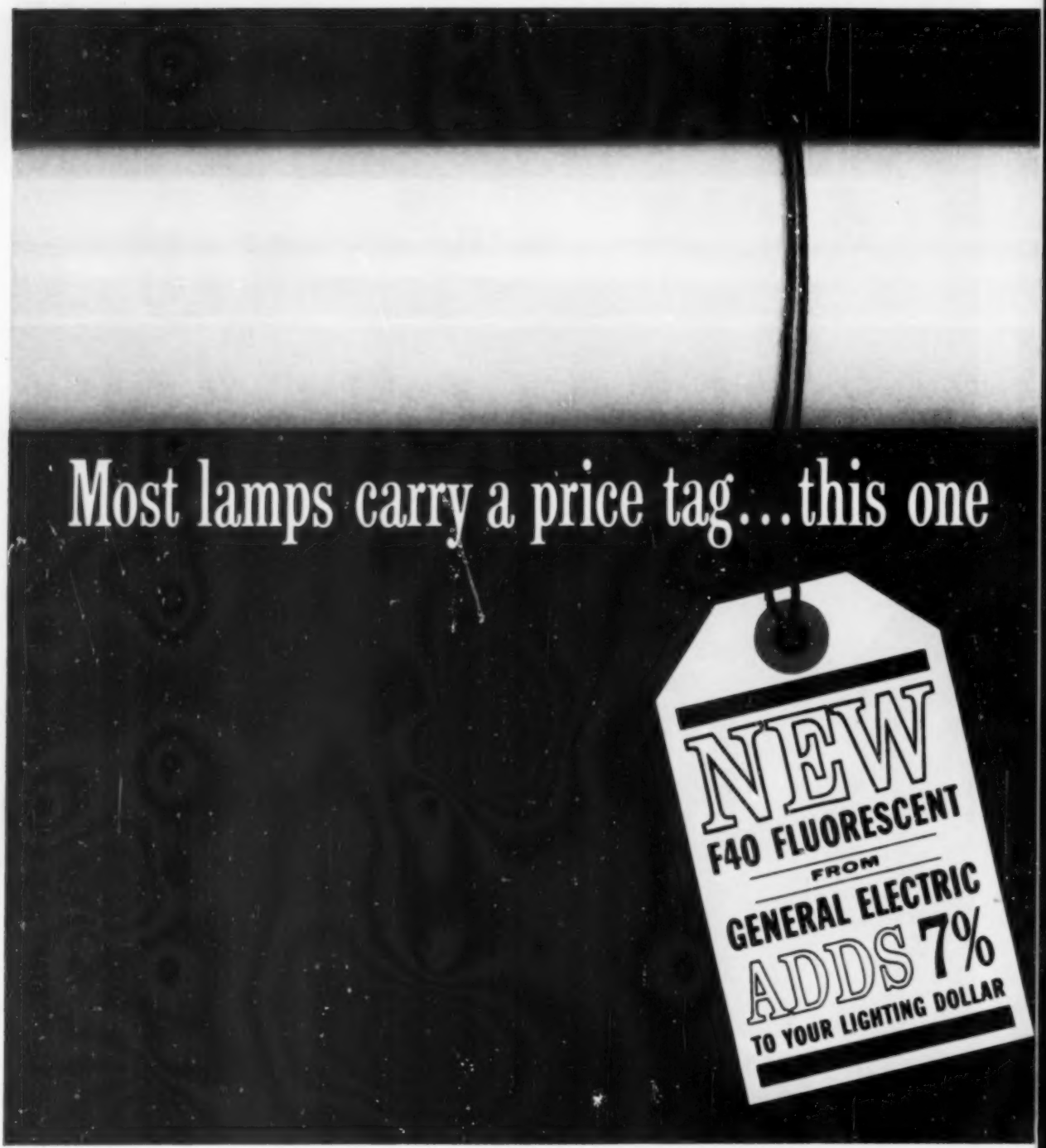
The PLEXIGLAS lenses are precisely designed optical elements that assure full utilization of light. They are strong and rigid, yet light in weight . . . will remain free of discoloration after years of exposure to fluorescent light. The result: another example of a magnificent building that uses PLEXIGLAS to obtain lighting of the highest quality.

We will be pleased to send you literature on PLEXIGLAS as a lighting material, and the names of manufacturers whose equipment includes PLEXIGLAS lenses and diffusers . . . for lighting that stands out and stands up.

ROHM & HAAS

PHILADELPHIA 5, PA.

In Canada: *Rohm & Haas Co. of Canada, Ltd., West Hill, Ontario*



NO INCREASE IN COST—yet a 7% increase in light. That's what you get from this newest General Electric lamp development—the new F40—that is setting a new standard for 40-watt fluorescent lamps. This value to you can be worth from 20% to over 100% of the lamp cost itself. You can increase lighting levels, get more for your investment in electricity, lamp and labor—all without spending a single extra penny. Depending on whether the ballasts you use were made before or after 1954, and the rate you pay for electricity, here's what you get: in total value, at least one-fifth of your lamp cost, and in most modern installations—more than your dollars and cents cost for lamps.

The Premium 3 construction features made possible by General Electric research give this new F40 a rating of

NEW F40

GENERAL ELECTRIC

brings you a bonus, too

ONLY 10 INCHES LONG

SERVICE BONUS: This 33,000-lumen G-E Quartzline† lamp never grows dim: gives continuous lighting power that older lamps could promise only at start of operating life.

MAINTENANCE BONUS: General Electric engineers sealed the reflector inside this Reflector Lamp—dirt can't enter; spotlighting costs less, maintenance is far easier.

TEMPERATURE BONUS: Another General Electric development—the All-Weather fluorescent gives good light even in refrigerated areas or outdoors year-round.

† Reg. Trade Mark General Electric Company

3100 lumens in popular cool white. In white or warm white it is rated at 3250 lumens. The list price is the same as ordinary 40-watt fluorescents—and the new F40 can be used in any 4-foot starter or rapid start system.

How can your company profit from this and other General Electric lamp improvements? Place your order for new F40 fluorescent lamps today with your General Electric lamp distributor. Or make sure that the man in your company who orders lamps knows about this and other bonus-value General Electric lamps. General Electric Company, Large Lamp Department C-126, Nela Park, Cleveland, Ohio.

Progress Is Our Most Important Product

GENERAL ELECTRIC

CHAIRMEN of IES Technical Committees gathered at the entrance of the new United Engineering Center. Occasion of their meeting was two-day Technical Forum November 6 and 7, to discuss progress and coordination of committee activities.

(*Continued from page* 10A)

chief engineer of Smith, Hinchman & Grylls Associates, Inc., Detroit architects and engineers. The survey indicated the need for authoritative standards of construction and performance in luminaires for commercial application, and urged RLM to assume responsibility for establishing the standards.

Preliminary to RLM activity in this new area, the Institute's technical committee prepared, and submitted to the membership, prototype specifications for recessed commercial fluorescent luminaires. Emphasis in the specifications is on lighting performance, quality of components (including temperature limits) and inspection and test procedures for certification and the RLM label in the new fields. It is expected that future specifications will follow the formula indicated by the prototype, except in the area of residential lighting.

Technical Committee Forum Meets at UEC

Chairmen of 18 technical committees of IES attended a two-day Technical Forum on November 6 and 7, sponsored by Senior Vice-President G. F. Dean and IES Technical Director C. L. Crouch. Purpose of the meeting was an interchange of information between active IES committees, and a report on progress of committee projects. The meeting was one of the first to be held at the new United Engineering Center.

Status of many of the Society's forthcoming technical committee reports was outlined by each chairman, during a progress session of the meeting. Coming up in the near future are recommended practice reports for school, daylighting, industrial lighting, color choice, light and air conditioning. A number of other reports are well into preliminary study.

AIEE, IRE Consider Merger

First steps toward a consolidation of American Institute of Electrical Engineers and the Institute of Radio Engineers into one international society have been announced jointly by Warren H. Chase, president of AIEE, and P. E. Haggerty, IRE president. The boards of directors of both societies have appointed a committee to consider the proposed merger and report by February 15, 1962. If the committee's plan is accepted by the membership of both organizations, the consolidation will take effect by January 1, 1963.

Present membership of the IRE is approximately 93,000; AIEE is an organization of almost 58,000 members.

Tar Heel Section Visits College Lighting Laboratory

A tour of the unique residential lighting laboratory at the Women's College of the University of North Carolina, Greensboro, N. C., was the program of a recent meeting of the IES Tar Heel Section. The laboratory, under the direction of Dr. Madeline B. Street, professor of home economics, is used as a workshop in conjunction with courses in lighting and wiring design, and housing and home furnishings. Originally conceived by a student in a senior thesis, the laboratory was built under the direction of Dean Naomi G. Albanese with funds contributed by the Tar Heel Section, Virginia Electric and Power Co., Duke Power Co. and Carolina Power and Light Co. Equipment was contributed by the local electrical industry.

The lighting section of the laboratory includes examples and flexible demonstrations of different light sources and lighting techniques for functional and decorative lighting. Structural walls provide students with the opportunity to measure reflectance values; a curtained area demonstrates the effects of folds and texture on light reflection; an off-white, matte-finished desk provides a third example of reflectance. A luminous ceiling, controllable to four lighting levels, is designed to teach measurement of illumination.

Good illumination principles for three lighting problem areas in the home—bathroom mirror, desk and dressing table units and reading area—are demonstrated in model areas. In designing lighting for the reading area, for example, students are required to determine type of lamp, type of diffusing material, relationship of lamp height to table and chair, etc.

Another area of the laboratory is equipped for the study of the effects of fluorescent and incandescent sources on colors and fabric textures used in an interior design. Dimming demonstrations are also available for both fluorescent and incandescent equipment.

A unique feature of the laboratory is a completely wired house plan showing

(*Continued on page* 16A)

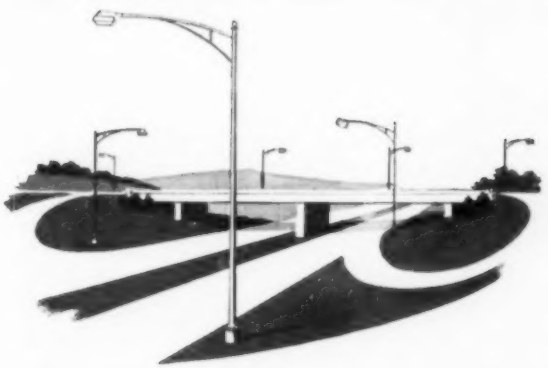
PROFESSOR Madeline B. Street of the Home Economics Department, Women's College, University of North Carolina, described residential wiring plan in the college's lighting laboratory to members of IES Tar Heel section touring laboratory.

for street lighting • highway lighting • floodlighting

UNION METAL MONOTUBE POLES

Monotube street lighting poles . . . steel or aluminum . . . round or fluted . . . davit or bracket styling . . . anchor or transformer base. Attractive in any location. Continuous-tapered Monotube poles are available in a broad range of designs and sizes to meet all requirements.

Monotube highway lighting poles are offered for various mounting heights and strength requirements. Easily wired and installed. Steel Monotubes are made from high grade, open hearth steel and cold-rolled for strength. Aluminum poles are either cold-rolled or spun.

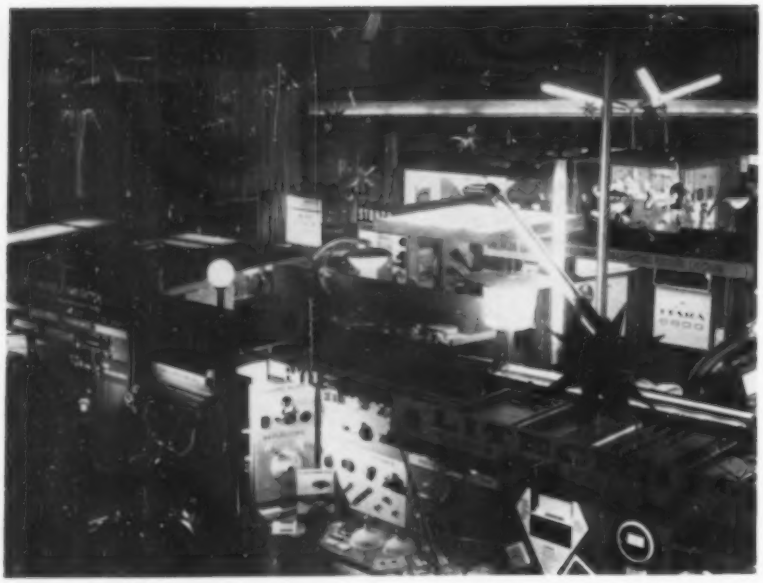


Monotube floodlighting poles . . . for sports, business, industrial or recreational areas. Available in heights from 20 to 100 feet. Monotube designs permit extreme flexibility in arrangement and number of light units per pole. Floodlights can be mounted, positioned and wired while pole is on the ground.

Complete design and specification data is readily available upon request. Write The Union Metal Manufacturing Company, Canton 5, Ohio. In Canada: The Union Metal Manufacturing Company of Canada, Limited, Brampton, Ontario.

UNION METAL

Monotube Lighting Poles



EXPOSITION floor at the Lighting Progress Exposition, held October 3-5 at the Hollywood Palladium. Forty manufacturers participated in the show.

(*Continued from page 14A*)

types and sizes of circuits necessary for today's adequately wired home. The plan has been designed to show each circuit serving a specific purpose with maximum convenience and safety.

Students using the laboratory are required to design lighting on varying budgets, coordinated with different interior design styles. As a supplement to the demonstration units, the laboratory has a library of colored slides showing good residential lighting designs for new homes and remodeled lighting designs in older homes.

California Lighting Show Successful, To Be Annual Event

Success of the first Lighting Progress Exposition, held October 3-5 at the Hollywood Palladium, has resulted in plans to hold an annual exposition designed specifically for western architects and engineers. Total attendance of 4180 at the show, while not as large as that at some expositions, represented a choice cross section of the lighting industry and associated professions. Attendance breakdown showed that visitors represented: public utilities, 9.9 per cent; electric and lighting companies, 35.3 per cent; architects and engineers, 17.4 per cent; miscellaneous, 37.4 per cent.

In addition to the trade show, featuring exhibits by 40 manufacturers of light sources and equipment, the exposition offered three symposiums on topics of current interest in the lighting field. Space conditioning for offices and stores was discussed by W. S. Fisher, commercial lighting specialist, General Electric Co., Cleveland, Ohio; W. F. Blitzer, vice-president for product development, Lightolier, Inc., Jersey City, N. J., spoke on lighting for tomorrow's living today; and lighting for industrial production was presented by Milton Buzan, product research department, Day-Brite Lighting Inc., St. Louis, Mo. Over 300 persons were in attendance at the symposiums, held twice daily.

Sponsor of the exposition was the Electric League of Southern California in conjunction with the Los Angeles Department of Water and Power, the Southern California Edison Co., and the California Light and Power Co. Roy H. Kreyser, Department of Water and Power, the IES South Pacific Coast Regional Vice-President, and Roy E. Dahlin, Southern California Edison Co., were co-chairmen of the symposium program. The exposition was produced by A. Howard Williams.

SPE Establishes Plastics Award

To honor outstanding achievements in the field of plastics, the Society of Plastics Engineers has established an International Award for fundamental contributions to plastics science and engineering. The Award, to be made for the first time at the Society's 18th Annual Technical Conference in Pittsburgh, January 30-February 2, 1962, consists of a gold medal and cash honorarium of $1000. Requirement for acceptance of the award is the preparation and delivery of a technical award lecture at the Society's annual technical conference.

The Award is to be made to one individual, except in unusual circumstances, without regard to sex, age, nationality or membership in the SPE. A recipient may be selected annually, although this is not mandatory.

The plastics Award originated in the SPE's New York Section as a memorial to a former member, the late Herbert Preiss. Aware of the Society's need for a major award and in an effort to enhance the prestige of the memorial, the Section turned over administration of the Medal to the international Society. In recognition of the Section's contribution, the Medal will carry the inscription "Sponsored by the New York Section."

Design of the Medal incorporates the SPE emblem and symbols depicting the four major segments of plastics science and engineering. Theory is represented by a molecular model; research by a flask, test tube and schlieren waves; resin production by towers of monomer and polymer plants; and plastics processing by a composite of symbolic equipment producing plastics sheet product from molding resin.

Sidelights!

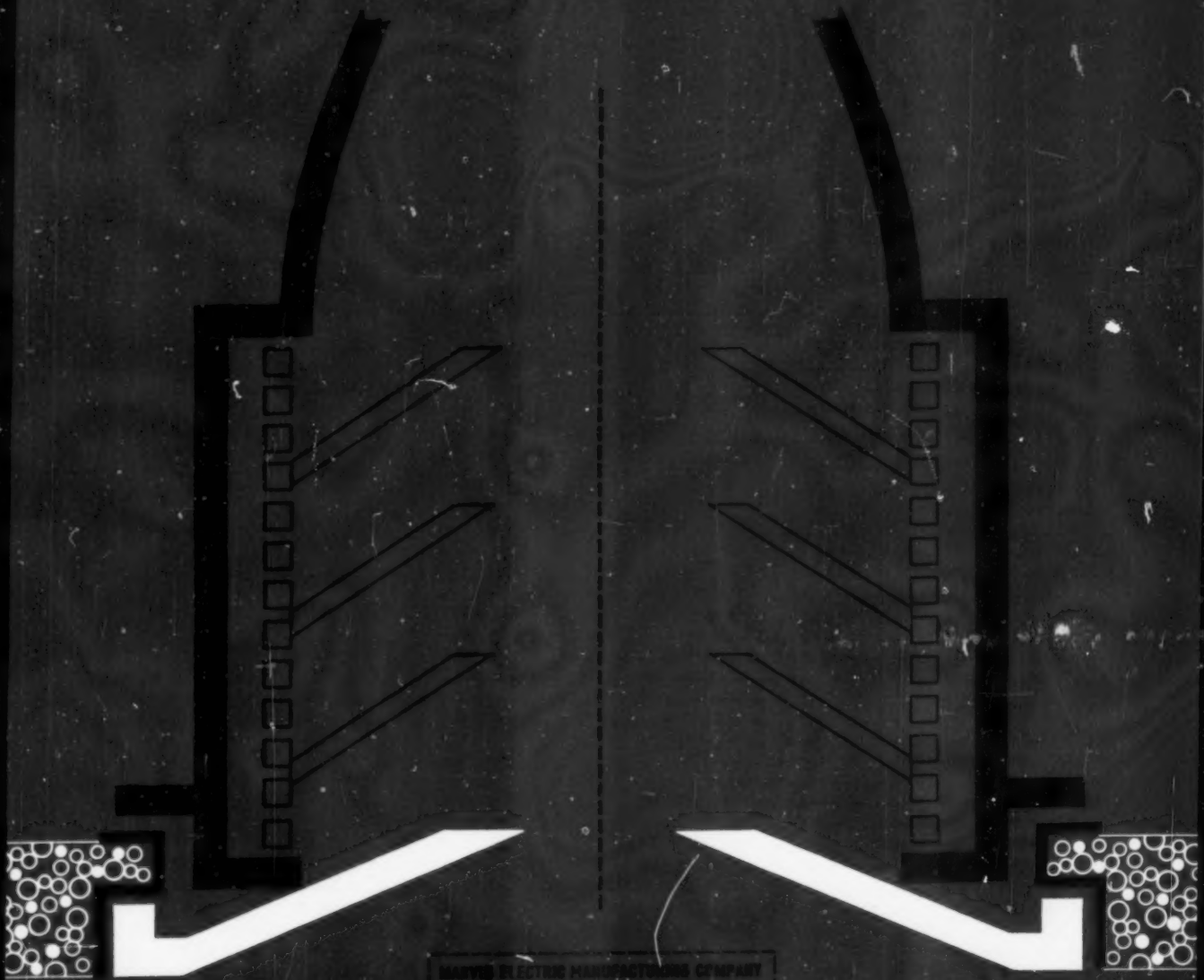
Electrical Week film . . . A filmstrip, "A New Definition of Power" designed for use at sales meetings, conventions, civic and industry meetings, etc., has been produced by *Life* magazine for use in conjunction with National Electrical Week, February 11-17, 1962. The 20-minute, full-color, 35-mm, sound film depicts the electrical industry in relation to its contributions to the American economy and consumer — past, present and future. Along with other NEW observance materials, the film is available from the National Electrical Week Headquarters, Suite 306, 407 N. 8th St., St. Louis 1, Mo.

U. S. leads in electric power . . . The United States holds an undisputed position of world leadership in the area of electric power and transmission systems, according to the Edison Electric Institute. Our power production in one year

(*Continued on page 18A*)

To avoid monotony in a series of ceiling-level lighting fixtures, Marco presents the "recessed recess" fixture. A minimum of trim confines the fixture which recedes upward towards aperture or lens. Result: an attractive, though unobtrusive light source performing its task with maximum efficiency. Use coupon below for handsome catalog illustrating over 100 new recessed lighting fixtures.

MARCO



MARCO ELECTRIC MANUFACTURING COMPANY
828 Santa Fe Avenue, Los Angeles 21, California

Please send me your new illustrated catalog on Innovation in Recessed Lighting

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1613

INCOMING Rocky Mountain Section chairman, Fred Rosenquist (second from right, photo at left) receives symbolic gavel from predecessor Jim Watson (third from left). Witnessing the ceremony, left to right: Jim Buck, board of managers; John Ake, secretary-treasurer; Gale Patterson, board of managers; Gregg Cloos, vice-chairman.

Photo at right, participants in Section's program on the new street lighting and traffic control system in downtown Denver. Left to right: Don Piper, program chairman; Charles Woodworth, moderator; speakers Jack Bruce and Dan Gibson, traffic and street lighting engineers, respectively, for the city and county of Denver.

(Continued from page 16A)

is greater than that of the next six countries combined, and three times that of the second-ranking Soviet Union. Over 312,000 miles of transmission lines of 35,000 volts and above are in use in the United States. The USSR, with 2½ times the land mass, has only 71,000 miles of comparable lines. Interconnected electric power systems have been in operation west of the Rocky Mountains for several years; nearly all systems east of the Rockies have now been interconnected. In contrast, only about one-fifth of the populated area of the Soviet Union has power networks and power systems.

Color "science" . . . Far from the complexities of colorimetry, but an interesting application of color, is its use for identification of fire hydrants in Independence, Kans. Colors used to tell firemen how many gallons of water per minute a plug can supply in an emergency are: black, less than 250 gallons per minute; red, 240 to 400; yellow, 400 to 750; green, over 750.

Lighting a fallout shelter . . . High-density (149 pounds per cubic foot) solid glass bricks, which transmit daylight yet provide radiation protection equal to that of solid concrete on an inch-for-inch thickness basis, have been approved for use in fallout shelters by the Office of Civil Defense. In practice, the bricks would be installed back to back in a wall to provide the required density, or mass, necessary for stopping deadly gamma radiation. Light transmission factor of a three-inch-thick brick is over 80 per cent. Three bricks, or a total of nine inches of solid glass, will transmit 54 per cent of the available light, more than is transmitted by the one-quarter-inch glare reducing glass used in many modern office buildings.

Retaining student members . . . Send December and May meeting notices to chairmen of student chapters for distribution to their members. This might bring students to IES Section/Chapter meetings in their home towns during school vacations and encourage them to affiliate with local groups after graduation. The idea, originating with Dr. M. E. Broom, acting president of the Southern College of Optometry, Memphis, and faculty adviser to the largest IES student group, might improve relations between students and the parent IES organizations.

Portable atomic power station . . . Soon to be installed in the Antarctic, for use by the U. S. Naval support facilities at McMurdo Sound scientific base, is a portable atomic power station capable of generating 1500 kilowatts of electrical energy. The energy is derived from a 55-gallon-size nuclear core — enough to operate the power plant for more than two years—buried deep in the ground.

The portable reactor plant can be flown to the installation site, assembled within 60 days and brought to full power in 15 days following completion of assembly. Vessels have a design pressure of 1500 psi and a design temperature of 600°F. They are 10 feet high, 3½ feet in diameter and installed in a stainless steel tank buried about 30 feet in the earth. Tanks are flooded with 20 feet of water to provide a biological shielding for personnel. Servicing is accomplished with specially designed buoyant tools.

Simulating light in space . . . A lighting system capable of duplicating illumination conditions found in outer space is being installed in an environmental space chamber now under construction at the Cal Tech Jet Propulsion Laboratory. The system uses approximately 150 high-pressure mercury-xenon lamps and an arrangement of lenses and mirrors to direct parallel beams of light at the space craft under test. Levels of light can be varied to reproduce the atmosphere encountered in various outer space orbits.

The lighting system is part of an environmental chamber designed to test space craft under realistic outer space conditions. Chamber walls will not emit heat nor reflect energy radiated by the craft under test, and an almost perfect vacuum will exist in the unit.

● ● ● ● ● ● ● ● ● ● ●

It Seems To Me . . .

Let's Abolish the Footcandle

If this title seems to smack of heresy, let me hasten to assure the reader that I propose not anarchy but simply clarity of communication. I propose that for the term "footcandle," we substitute the expression "lumens per sq. ft." We say frequently that we "light" buildings or spaces; yet what we really do is irradiate them with luminous energy, lighted planes and surfaces being a direct consequence of this action.

Invisible luminous energy is mysterious enough to the layman. My contention is that we can effect a significant simplification in our terminology by adopting the expression "lumens per sq. ft." Immediately the effect is related to the cause, and thinking re-

(Continued on page 21A)

Kopp Lighting Glassware

LENSES . . . COLOR FILTERS . . . COVER GLASSES

Some of more than 1,000 Kopp-engineered custom-produced products

• • •

Flat fresnels for interior lighting

Lighting lenses for beam control

Heat-resisting glassware for outdoor color effects

Color-correcting glasses for lighting museums and art galleries

Heat-resisting floodlight cover glasses

Show window color filters

Heat-resisting theatrical and TV spotlight lenses

Surgical and dental lighting glassware

Industrial sight glasses

Traffic signal lenses

Lenses for interior or exterior aircraft lights

Lenses and color filters for airport runway lights

Automotive warning light domes

Railroad signaling lenses

Ultraviolet and Infrared glasses

Heat-resisting and, or tempered glasses

KOPP GLASS

Designed to meet your precise requirements in lighting distribution, color transmission, etc.

You can frequently save time and money by consulting with Kopp engineers before your design specifications are finalized. We may be able to reduce costs by suggesting changes in size, shape, dimensional tolerances, or composition and still give you the performance you want.

Write or call us *today* about your problem. In over 50 years, Kopp Glass has designed and custom-produced a wide variety of products to solve special lighting problems. Typical examples are given on the right.

Kopp's team of engineers and glass technologists are fully qualified to review your individual application, develop the composition of the glass, design the molds, and establish manufacturing procedures for the product you need. The result will be accurate and lasting colors, proper light transmission and distribution, controlled physical characteristics—in fact, the exact combination of properties that best meets your requirements.

Ask for copy of new brochure "This is Kopp Glass"

Kopp Glass, INC.

Swissvale, Pennsylvania

Here and There . . . More

Oregon Section members lunching with eye patches as a demonstration of the value of binocular vision are, right to left: Jack Cottingham, Pacific Northwest RVP; Jim Beck, secretary-treasurer; Ralph Wickham, vice-chairman; Al Natalic, chairman. Purveyor of the patches, Dr. Raymond Roy (left), optometrist, was guest speaker at Section's October meeting. Photo: W. A. Cyr, *Electrical West*.

Color usage for higher lighting levels was subject of talk by James A. Meacham, The Sherwin-Williams Co., (seated at right at head of table) at a luncheon meeting of Cleveland Section. Seated left at head of table, Cleveland chairman, Carl J. Allen; standing, Morgan Christensen, program chairman. Seventy-three members and guests attended the meeting.

El Paso Chapter's charter was presented by Intermountain Regional Vice-President, Robert Godemann (left) to Mrs. Vivian Hamilton, chairman of the 97th IES local group. Among the guests at the banquet celebrating the chartering were El Paso's mayor, Ralph Seitsinger; outgoing Intermountain RVP, Lloyd Reed; William Benndorf, chairman of IES Arizona Section. A tour of the lighting in the new El Paso art museum was arranged by the Chapter for out-of-town guests on day after the banquet.

New York Section was host to J. M. Waldram (second from left), research engineer, General Electric Co., Ltd., Wembley, England, at a recent meeting. Mr. Waldram, who was in the United States for the presentation of a paper at the IES National Conference, spoke on lighting and architecture. Shown here with Mr. Waldram, l. to r.: R. L. Zahour, Northeastern RVP; R. G. Williams, New York Section chairman; Mrs. Williams; Irving Fishman, chairman, illumination division, AIEE New York Section.

(Continued from page 18A)

volves around energy concentrations rather than the abstraction conveyed by a hypothetical candle facing a hypothetical curvilinear square foot of surface. Our more rational counterparts in other parts of the globe have adopted the energy density relationship in the interest of logical communication, and I suggest that the IES might well consider lending official support to a similar approach.—D. C. FIELDING, Federal Pacific Electric of Canada, Toronto.

Insidious Glare

Since the organization of the Illuminating Engineering Society, 55 years ago, attempts have been made to select an appropriate adjective for the description of glare. Indeed, none of the basic dictionary definitions of the word seem to fit the needs of the lighting profession. It was not until approximately ten years after the formation of the Society that several definitions of glare were suggested by a technical committee. The definition which has found most general acceptance in lighting literature is "brightness within the field of view of such character as to cause discomfort, annoyance, interference with vision or eye fatigue." Subsequently, such expressions as *discomfort glare*, *blinding glare* (now known as *disability glare*), *veiling glare*, *reflected glare*, etc., have come into use. Some lighting engineers object to the term glare altogether as being indefinite and unscientific.

The term "insidious glare" is both indefinite and unscientific. However, it is offered here in the hope of encouraging the lighting profession to think and act about a problem which is known to exist, but which has become so much a part of daily life as to be considered a matter of course and unpreventable. I refer, of course, to the reflected glare from almost all reading material, which forces us to change our positions or that of the reading matter.

The reflected brightness of a shiny, black printing ink may, at certain points, be equal to, or greater than, that of the paper upon which it is printed. This, naturally, decreases the contrast which is supposed to exist between the black ink and the white paper. Under many conditions, such as when reading beside a good floor lamp, it is simple to dodge this glare. But, there are circumstances in which dodging is inconvenient or impossible. This imposes a handicap upon a sufficiently large number of people to justify the expense involved in the installation of a lighting system that will eliminate this nuisance.

In areas such as classrooms, general offices, library reading and reference

(Continued on page 24A)

SCHEDULED EVENTS

1962 Dates of Interest to IES Members

January

January 8-12—Highway Research Board, 41st Annual Meeting, Sheraton-Park Hotel, Washington, D. C.

January 22-25—National Plant Maintenance & Engineering Show, Convention Hall, Philadelphia, Pa.

January 25-27—National Society of Professional Engineers, King Edward Hotel, Jackson, Miss.

January 29-31—American Society of Heating, Refrigerating and Air Conditioning Engineers, Semi-Annual Meeting, Chase Park Plaza, St. Louis, Mo.

January 29 - February 2—Electrical Engineering Exposition, sponsored by the American Institute of Electrical Engineers, New York Coliseum, New York, N. Y.

January 30 - February 2—Society of the Plastics Engineers, Annual Technical Conference, Penn-Sheraton Hotel, Pittsburgh, Pa.

February

February 5-9—American Society for Testing Materials, Statler-Hilton Hotel, Dallas, Texas.

February 6-8—Society of the Plastics Industry, Reinforced Plastics Division Conference, Edgewater Beach Hotel, Chicago, Ill.

February 8-9—IES Council Meeting, United Engineering Center, 345 East 47th St., New York, N. Y. Members are invited to attend meetings of Council as guests.

March

March 2-4—20th National Home Improvement Exposition, New York Coliseum, New York, N. Y.

March 9-11—National Electrical Industries Show, New York Coliseum, New York, N. Y.

March 12-13—Inter-Society Color Council, Annual Meeting and Color Symposium, Statler Hotel, New York, N. Y.

March 15-17—Optical Society of America, Spring Meeting, Mayflower Hotel, Washington, D. C.

March 28-31—Eleventh Biennial Electrical Industry Show, sponsored by Electrical Maintenance Engineers Association of California, Shrine Exposition Hall, Los Angeles, Calif.

April

April 2-4—Edison Electric Institute Annual Sales Conference, Edgewater Beach Hotel, Chicago, Ill.

April 9-10—IES East Central Regional Conference, Traylor Hotel, Allentown, Pa.

April 12-13—IES Southeastern/South Central Regional Conference, King Edwards Hotel, Jackson, Miss.

April 16-17—IES Great Lakes Regional Conference, Dayton Biltmore Hotel, Dayton, Ohio.

April 24-26—Building Research Institute, Spring Conferences, Shoreham Hotel, Washington, D. C.

April 30-May 3—Design Engineering Show, McCormack Place, Chicago, Ill.

April 30-May 4—Society of Motion Picture and Television Engineers, Semi-Annual Convention, Ambassador Hotel, Los Angeles, Calif.

May

May 6-10—Electrochemical Society, Annual Meeting, Statler Hilton Hotel, Los Angeles, Calif.

May 10-11—IES Midwest/North Central Regional Conference, Radisson Hotel, Minneapolis, Minn.

May 14-15—IES Canadian Regional Conference, Winnipeg, Man.

May 17-18—IES Pacific Northwest Region Conference, Davenport Hotel, Spokane, Wash.

May 21-22—IES South Pacific Coast Regional Conference, U. S. Grant Hotel, San Diego, Calif.

May 24-25—IES Inter-Mountain Regional Conference, Western Skies Hotel, Albuquerque, N. M.

June

June 4-6—Edison Electric Institute, Annual Convention, Atlantic City, N. J.

June 11-12—IES Northeastern Regional Conference, Hotel U. S. Thayer, West Point, N. Y.

June 13-16—National Society of Professional Engineers, Annual Meeting, Sheraton-French Lick Hotel, French Lick, Ind.

June 14-15—IES Council Meeting, United Engineering Center, 345 E. 47th St., New York, N. Y. Members are invited to attend meetings of Council as guests.

June 18-21—National Association of Power Engineers, National Convention, Statler Hilton Hotel, Washington, D. C.

June 27-29—Conference on Standards and Electronic Measurements, sponsored by the Institute of Radio Engineers, American Institute of Electrical Engineers and the National Bureau of Standards, Boulder, Colo.

September

September 9-14—Illuminating Engineering Society, National Technical Conference, Statler-Hilton Hotel, Dallas, Texas.

September 24-26—National Power Conference, sponsored by American Institute of Electrical Engineers and American Society of Mechanical Engineers, Lord Baltimore Hotel, Baltimore, Md.

CHAMPION

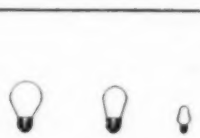
COMMERCIAL AND INDUSTRIAL LAMP SPECIALISTS SINCE 1900

Fluorescent • Incandescent • Mercury Vapor • Infra-Red

CHAMPION LAMPS

LAMPS

are one of the four lines listed as meeting the quality specifications of the U.S. Bureau of Standards



CHAMPION LAMPS

LYNN, MASS. LYnn 3-2000

(Continued from page 21A)

rooms, where reading on more or less glossy paper is the prime visual task—and the reason for the existence of the lighting system—illumination should be designed to minimize glare. In view of the simple procedure required to conduct comparative test trials, there would not seem to be any justification for the installation of lighting systems which will give only second- or third-rate results.

Definite and effective remedies for insidious glare have been known and tried for several years. These include:

(1) A properly designed luminous ceiling of fairly uniform brightness from wall to wall;

(2) A properly designed indirect or semi-indirect lighting system of fairly uniform brightness from wall to wall.

The brightness of the troughs or bowls in a semi-indirect system should be fairly close to the brightness of the ceiling above for the very best results. Ceilings lower than eight feet should not be used with either (1) or (2).

Do not ask what "fairly uniform brightness" is! For some time, I have tried, unsuccessfully, to inspire research on that question. At present, all we can do is refer to the *IES Lighting Handbook*, Third Edition, page 9-22, to obtain mounting heights and spacing for fluorescent lamps in luminous ceilings. That is, place rows of lamps so that their distance above the diffusing ceiling is not less than two-thirds their distance apart. For indirect systems, hang troughs below the reflecting ceilings at least two-thirds their distance apart. Until further data are available on the spacing limits for satisfactory reading results (with the simple test mentioned later), the foregoing figures will provide satisfactory results.

I have titled this article "insidious glare" because I have become convinced that few of our members, and fewer architects, attach any importance to its existence. For example:

(1) Tests made by Professor D. M. Finch and myself, in preparation for a paper on "Brightness Factors" (ILLUMINATING ENGINEERING, August 1956), indicated the desirable quality of the spread out brightness from luminous ceilings for eliminating the causes of this glare. When these tests were discussed with the manager of a luminous ceiling company, he said that although the results were true and interesting, this quality of the illumination was apt not to be the governing factor in the selection of the luminous ceiling.

(2) In the "IES Recommended Practice for Office Lighting," both 1956 and 1960 editions, this kind of glare was given a subhead and ably discussed, but no general and sure remedy, in the form of a proper lighting system was given. The Practice only mentions several makeshifts for palliating this evil.

(3) A recent advertisement in ILLUMINATING ENGINEERING, by a manufacturer of one of the essential luminous ceiling elements, described the advantages of luminous ceilings without mentioning them as a remedy for the reflected glare nuisance—the strongest single reason for their use.

The test for insidious glare is very simple. It can be made by anyone who can read. Take a copy of ILLUMINATING ENGINEERING, or any magazine or bulletin printed on similar paper. Read, with the magazine in many different positions, under the lighting installation to be tested. If a properly designed luminous ceiling or indirect lighting system is not easily accessible for comparison, compare the results with those obtained outdoors, on a clear day, in the shade of a building with a large expanse of open sky, or on a fairly uniform overcast day in a relatively wide open area. The absence of insidious glare will be noticed, readily, when it is experienced!—JAMES R. CRAVATH, Charter Member, IES, Retired, Berkeley, Calif.

1962 Conference Paper Outlines Due January 31

The IES Papers Committee announces that outlines of proposed papers for the 1962 National Technical Conference in Dallas must be submitted by January 31, 1962. All submissions should make clear the intended scope of the paper and indicate features of the work that will justify its presentation and publication. Outlines should be sent to:

Benjamin S. Benson, Jr.
Chairman, IES Papers Committee
Benjamin Division, Thomas Industries, Inc.
Des Plaines, Ill.

ABOUT PEOPLE

Parenthetical designations indicate membership grade in the Society.

Two General Electric Co. sales managers, representing a total of 73 years with the company, plan to retire in the coming year. **T. P. Brown** (M), currently manager of the Michigan Sales District, joined GE in 1922 as an engineer at Schenectady, N. Y. He became Detroit sales manager in 1957. Mr. Brown is a recognized authority on the development of new factory lighting systems for the automotive industry. He will be succeeded by **Michael C. Finn** (A) of Minneapolis.

Warren P. Thayer (M) will retire as manager of the Allegheny Sales District of General Electric Co., Pittsburgh, Pa. Mr. Thayer has been with the company since 1924, serving in lamp sales at Harrison, N. J., and Indianapolis and Fort Wayne, Ind. He was promoted to sales manager of the midwest sales district centered in Kansas City, Kans., in 1945, a position he held until moving to Pittsburgh as manager of the Allegheny sales district in 1949. To succeed him as manager is **Robert A. Mehaffey.**

Also announced by General Electric Co. are the appointments of **Charles K. Rieger** as vice-president and group executive to succeed **Clarence H. Linder** in the company's Electric Utility Group, Schenectady, N. Y.; and the appointment of **L. R. Anderson** of Milwaukee as manager of the northern sales district headquartered in Minneapolis, Minn.

Roger E. Gay, former president of the Bristol Brass Corp., will succeed vice-admiral **George F. Hussey, Jr.,** USN (Ret.) as managing director of the American Standards Association effective January, 1962. Mr. Gay is leaving his management consultant practice to be-

(Continued on page 26A)

Litecontrol Vistalumes perform highly functional, pleasantly decorative role for both employees in first floor Purchasing Office (main photo) and machines (inset) at Data Processing Center on fifth floor, Gillette Safety Razor Co., South Boston, Massachusetts.

Recessed-Fixture **APPEARANCE** *without Recessed-Fixture Cost*

Fast, Easy Cleaning *without Expensive Maintenance Time*

. . . reasons why LITECONTROL Vistalumes were installed at Gillette Note the unobtrusive style of Litecontrol Vistalumes. Their shallow housing literally hugs the ceiling to provide a uniform recessed appearance down the line. Refined design does away with metal frames that clutter and darken rows of fixtures. Total absence of shadows produces really evenly lighted diffusers. *Important design point:* Matching two and four lamp fixtures aid in designing integrated layouts for areas with varying intensity demands.

Plastic diffusers are cleaned easily and quickly without fuss or muss. Just press a finger to open, unsnap hinges to remove diffuser, wash and replace.

The diffusers are light-stable and conform to the IES-NEMA-SPI specifications for Class C (ultraviolet light stabilized) styrene.

How about your next lighting project? Whether big or small, for people, machines, or both, Litecontrol's complete line of fixtures can provide excellent performance in your lighting layouts.

We'd be happy to work with you. Send for brochure and specification sheets.

INSTALLATION: Gillette Safety Razor Co., So. Boston, Mass.
AREA SHOWN: Purchasing Office and Data Processing Center
ENGINEER: Ganteaume & McMullen, Boston, Mass.
ELECTRICAL CONTRACTOR: Hixon Electric Co., Boston, Mass.
DISTRIBUTOR: Graybar Electric Co., Inc., Boston, Mass.
CEILING HEIGHT: Approximately 8′ — 0″
FIXTURES: Litecontrol No. 100224RS 2-lamp and 10044RS 4-lamp Vistalumes surface mounted.

LITECONTROL
LIGHTING
LITECONTROL CORPORATION,
36 Pleasant Street, Watertown 72, Massachusetts

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

Installations in the News . . .

LIGHTED CHRISTMAS CONES

Colorful, three-foot-high plastic cones mounted on conventional lamp bases form attractive outdoor decorations during the Christmas season. Light diffused through the translucent plastic supplies a warm glow at the exterior of the home.

The cones, which consist of an extruded outer skin of Tenite butyrate plastic skin sealed to a cone-shaped plastic core, are impervious to winter weather. Colored patterns are silk-screened onto the underside of the butyrate surface to protect them from wear and exposure. Photo and data were supplied through the courtesy of Eastman Chemical Products, Inc., New York, N. Y.

(Continued from page 24A)

come the third managing director of the 43-year-old voluntary national standards body. President of ASA from 1952-1954 and a member of its board of directors for nine years, he is also a Fellow of the Standards Engineers Society. In 1957 he was the recipient of the annual award of the SES and the American Society for Testing Materials.

Dr. Leonard Mead of the Tufts University has been elected chairman of the IERI Executive Committee. He replaces **Professor E. M. Strong** (F) of Cornell who has served in that position many years. Other actions of the Illuminating Engineering Research Institute included the re-election of **A. F. Wakefield** (M) as chairman of the board of trustees; re-election of **Dr. R. M. Zabel** (F), and the election of **Warren H. Edman** (M) to the board of trustees.

Raymond E. Wozniak (A), consultant and lecturer on illuminating engineering problems with the Chicago Lighting Institute for ten years, has joined Halo Lighting Products, Inc., Chicago, as a lighting engineer. Active in IES for a number of years, Mr. Wozniak was chairman of the subcommittee which prepared the recently published *Lighting Fundamentals Course*. He has also served on the Society's commercial kitchens committee, commercial dining room lighting and educational committees, as well as numerous committees of the IES Chicago Section. Another addition to Halo's staff is **Jim Wolfson** as national sales manager of the architectural lighting division.

Leo Dolkart, Member Emeritus and charter member of IES, has been cited by the Chicago Technical Societies Council for its 1961 Merit Award. This award is made annually to distinguished scientists in the Chicago area on the basis of their scientific and technical achievements and their contributions to civic betterment. A recipient of the 1956 Merit Award and the IES Golden Anniversary 50-year pin, Mr. Dolkart has served on the street lighting, institutional and lighting study projects committees, and has contributed to several editions of the IES handbook.

Christos C. Mpelkas will fill the newly created position of plant physiologist for the Lighting Products Division of Sylvania Electric Products, Inc. Mr. Mpelkas will head studies in plant physiology and its relationship to lighting.

Smithcraft Lighting Corp. of Chelsea, Mass., announced the appointment of **Perry G. Sessoms** (A) as representative for the state of Georgia. Mr. Sessoms will operate from Atlanta, Ga.

James A. Reeves (A) has rejoined Meletio Electrical Supply Co., Dallas, as a special lighting consultant. In his new post, Mr. Reeves will serve as a consultant to commercial, industrial and other large building operators and developers. Mr. Reeves, who had been with the company from 1945 to 1957, also served as factory representative in the sales department of another Dallas electrical firm.

David C. Norris has been named manager of electric sales for Unistrut Products Co., Chicago, Ill., **John P. Heslin,** vice-president in charge of marketing, announced recently. Mr. Norris was formerly national sales manager, Globe Co.

Chosen to fill the new position of director of engineering for Kurz & Root Co., Appleton, Wis., and its subsidiaries, Kurz & Root Sales and Engineering Corp., is **Robert H. Lee,** who formerly held the same position with Basler Electric Co., and its affiliate, Power Supplies, Inc., of Highland, Ill.

Mary E. Webber (FE), who retired recently from General Electric Co., Cleveland, Ohio, has been elected Fellow Emeritus by the IES Council for her outstanding "contributions to the advancement of the art and science of illumination in home lighting."

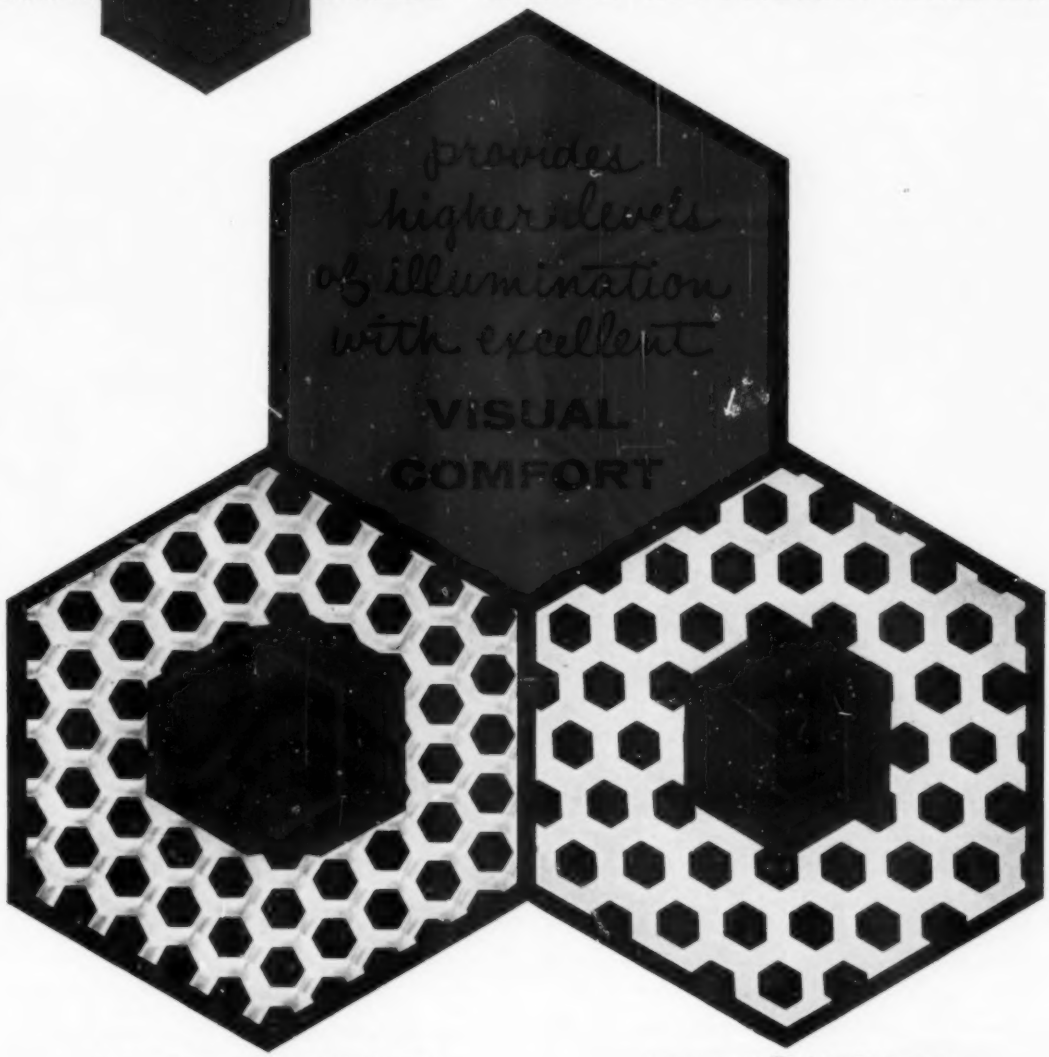
Two new technical sales representatives have been appointed by Union Carbide Plastics Co., division of Union Carbide Corp. **K. C. Monroe** will cover the western sales region from the company's San Francisco sales office, and **Allen J. Costantin** has been assigned to the midwestern region with headquarters in Dallas.

Garden City Plating & Mfg. Co., Chicago, Ill., has changed its 63-year-old name to Garcy Corporation. **J. W. Metelnick** (A), general manager of Garcy Lighting, said the corporate name change

(Continued on page 29A)

NEW NEW NEW NEW NEW NEW NEW

SINKO PARAHEX* LOUVERS' New Parabolic Construction



Bottom View of PARAHEX Louver

Top View of PARAHEX Louver

When the PARAHEX Louver is used in its metalized finish and is installed in fixtures and/or luminous ceilings, it controls the lamp brightness so well that it is sometimes difficult to distinguish whether or not the lamps are actually lighted — yet the PARAHEX Louver may be providing a maximum of illumination levels.

The new PARAHEX Louver offers new applications in lighting design and adds new functional beauty to lighting installations.

Not only is the PARAHEX a new advancement in lighting comfort, but it is also an outstanding achievement in the field of plastic molding. In the PARAHEX, Sinko has again proven its ability to meet the challenge of molding the unusual.

PARAHEX Louvers are available in one piece, nominal 2 ft. by 4 ft. panels, in either translucent white Polystyrene, specular and satin aluminum vacuum plated metalized finishes, and in Acrylic, either translucent white or crystal clear. PARAHEX cell dimensions are 1/2" high x 3/8" x 9/16" with 45° x 45° shielding.

We invite you to write today for design samples and engineering data sheets.

SINKO louvers

SINKO MANUFACTURING & TOOL CO.

7310 W. Wilson Avenue • Chicago 31, Illinois

In Canada:
Sinko Manufacturing & Tool Co. of Canada, Ltd. 3550 Frobisher Street, Montreal, Quebec

*Manufactured under License from General Electric Company Pat. No. 2971083

Niagara-Mohawk Power Corporation, Huntley Station, Buffalo, New York.

Power company selects Abolite...

Gets easy-on-the-eyes lighting, and holds the line on costs

INSTALLATION DATA

Abolite HMFAU-2400 Alzak aluminum uplight fixtures with 1000 watt color-improved mercury lamps. Ceiling height 65', mounting height 55', spacing 18' x 24'. Average maintained footcandle level: 30.

Electrical Contractor: Buffalo Electric Co.

Engineers at this power plant wanted high bay lighting that combined comfort with low installation and maintenance costs. They got it by installing Abolite fixtures equipped with 1000 watt color-improved mercury lamps.

Though these fixtures are mounted 55 feet high, they provide comfortable, glareless 30 footcandle average light throughout the building. Light directed upward through the fixtures' open tops washes out dark ceiling shadows. 35° shielding of lamp virtually eliminates glare.

Most important, this system costs less to buy and maintain than a comparable fluorescent system because fewer fixtures are needed. Maintenance costs are less, too, because air circulating through Abolite's open-top fixtures sweeps them clean of dulling dust.

For high bay lighting that combines both comfort *and* economy, specify Abolite fixtures. The complete line includes RLM-approved Alzak aluminum and porcelain enamel fixtures for use with all kinds of mercury and incandescent lamps. Write for more information.

ABOLITE *Lighting*

THE JONES METAL PRODUCTS COMPANY

West Lafayette, Ohio

*Manufactured under License from General Electric Company Pat. No. 2971083

(*Continued from page 26A*)

symbolizes several moves the parent company has made to strengthen its organization, broaden its markets and increase its production capacity.

New officers were chosen at the 35th annual meeting of the National Electrical Manufacturers Association in New York, November 16. **Homer L. Travis,** vice-president in charge of sales, Kelvinator Division, American Motors Corp., Detroit, Mich., was elected president, succeeding **A. D. R. Fraser,** Aluminum Co. of America, Rome, N. Y. **E. R. Perry,** president of the National Vulcanized Fibre Co., Wilmington, Del., was elected vice-president to succeed **W. R. Persons,** president, the Emerson Electric Mfg. Co., St. Louis, Mo. Mr. Perry is also chairman of NEMA's Insulating Materials Division. **A. E. Pringle, II,** president, The Pringle Electrical Mfg. Co., Philadelphia, Pa., was re-elected treasurer of the Association.

Recently appointed as sales representative for Continental Electric Equipment Co., Ludlow, Ky., **Peter Schurman** will cover New York City and the southeastern third of the state, and Long Island.

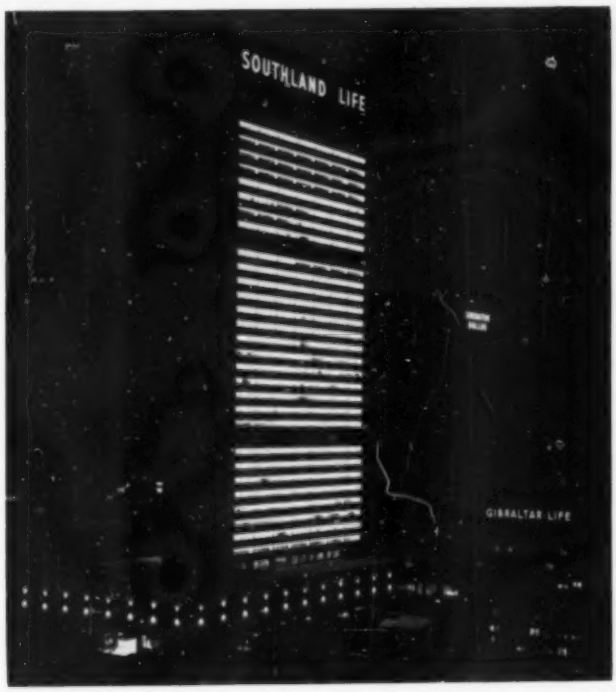
Re-elected at the annual meeting to fill the post of president of RLM Standards Institute for 1962 was **E. F. Mulligan,** president of Jones Metal Products Co. **Richard G. Slauer** (F), 1960-1961 president of IES, was elected as vice-president and **James R. Chambers** (M), 1961-1962 IES president, was elected a member of the RLM Board of Trustees.

Charles Lehrman has been chosen director of sales for Gill Glass and Fixture Co., a new division of Progress Mfg. Co., Philadelphia, Pa., according to a recent announcement by **Will Turner** (A), president. Also announced was the recent promotion of **Elliot Fox** to senior sales representative for all product lines in the Virginia and North Carolina areas, with headquarters in Richmond, Va. **Martin J. Lampe,** newly added to the staff of Progress, will cover Alabama and parts of Florida and South Carolina as senior sales representative.

Formerly a director and controller of Litecraft Industries, Ltd., Passaic, N. J., **Gerald E. Morris** has been elected executive vice-president and treasurer of the company. **Theodore Winischuh,** assistant controller, has been appointed to fill the vacancy created in the controllership.

To Be Seen in Dallas

For visitors to the IES National Technical Conference in Dallas next September, most prominent feature of nighttime skyline will be Southland Life building. The massive tower of light was created by mounting 2436 four-foot, high-output fluorescent lamps immediately inside each window. White-lined draperies are drawn between light strips and offices.



W. K. Turner has been appointed as Seattle representative of The Kirlin Co. in the Seattle-Tacoma area.

D. Grant Mickle, former director of the Automotive Safety Foundation's Traffic Engineering Division, has been appointed to the newly created post of deputy federal highway administrator of the Bureau of Public Roads by Secretary of Commerce **Luther Hodges.** This new position was established by Congress this year when the position of Commissioner of Public Roads was abolished. In his new capacity, Mr. Mickle will be chief assistant to Federal Highway Administrator **Whitton.**

The Society of Plastics Engineers, Inc., has elected **James R. Lampman,** General Electric Co., Syracuse, N. Y., as 1962 president. Also elected at a recent Council meeting in Detroit were: **John M. Berutich,** Haveg Industries, Inc., as vice-president, engineering; **Richard B. Bishop,** Holy Cross College, Worcester, Mass., as vice-president, administration; **George P. Kovach,** Foster Grant Co., Inc., as secretary; and **Samuel H. Greenwood, Jr.,** F. J. Stokes Corp., Philadelphia, Pa., as treasurer.

Three top executive changes have been announced by Efengee Electrical Supply Co., Chicago. **Joseph Fink,** former presi-

(*Continued on page 30A*)

(*Continued from page* 29A)

dent of the company, has been named chairman of the board of directors. Succeeding Mr. Fink as president is **Saul J. Weinress,** elevated from the position of executive vice-president. The office of executive vice-president will be filled by **James J. Ryan.**

Several assignments and organizational changes within the Merchandise and Builder Products Sales department at Emerson Electric Mfg. Co., St. Louis, Mo., were announced: **Robert D. MacCloy** as advertising manager; **Charles Parker** as contract sales manager; **Bruce Ross** as sales manager-electric heat; **James Burton** as sales manager-national accounts. In addition to his present responsibility as assistant manager, **Louis L. Colbert** has been assigned specific responsibilities for the department's lighting and electric heat products, the field specialists in these areas, and new business development.

LOCAL HERO, Carl Johnson (center), winner of first prize in Class II of the National Applied Lighting Competition for his lighting of the American Airlines Terminal (November IE) was honored by New Jersey Section. Shown here offering congratulations are (left) R. L. Zahour, Northeastern Regional Vice-President, and Meyer H. Silverman, New Jersey Section chairman.

NEW MEMBERS

At the November 9, 1961, meeting of the IES Council in New York City, the following were elected to membership. Names marked * are transfers from Associate to Member grade.

CANADIAN REGION

Bluenose Chapter

No Elections

Forest City (London) Chapter

No Elections

Golden West Chapter

Associate Members:

Badger, J. C., Angus, Butler Engineering Ltd., Regina, Sask.

Blakley, J. K., L. H. Ritenburg & Associates Ltd., Regina, Sask.

Hamilton Ontario Chapter

No Elections

Maritime Section

No Elections

Montreal Section

Associate Members:

Cress, E. A., Rest-Glow Mfg. Co., Town of Mount Royal, Que.

Gagne, J. R. B., Dominion Sound Equipments Ltd., Montreal, Que.

Lex, J. F., Foundation of Canada Engineering Corp. Ltd., Montreal, Que.

Pellerin, J., Barre Pellerin-Poirier, Montreal, Que.

Northumberland Chapter

No Elections

Ottawa Section

No Elections

Quebec Chapter

No Elections

St. Maurice Valley Chapter

No Elections

Toronto Section

Associate Members:

Abram, D. K., Toronto Hydro-Electric System, Toronto, Ont.

Clague, V. G., Scarborough Public Utilities, Scarborough, Ont.

Diamond, S. M., Integrated Lighting Ltd., Toronto, Ont.

Grant, B., Seven-Eleven Employment Service, Toronto, Ont.

Henson, J. W., L & H Enterprises, Streetsville, Ont.

McCormick, R. E., Northern Electric Co. Ltd., Toronto, Ont.

Winnipeg Chapter

Associate Member:

Walsh, R. J., L & S Electric Mfg. Ltd., Division James B. Carter Ltd., Winnipeg, Man.

EAST CENTRAL REGION

Blue Ridge Chapter

Associate Members:

Britt, R. W., Sowers, Rodes & Whitescarver, Roanoke, Va.

Slaydon, P. V., Roanoke V. A. Hospital, Salem, Va.

Capital Section

No Elections

Eastern Pennsylvania Section

No Elections

Maryland Section

No Elections

Philadelphia Section

Associate Member:

Gamble, A. C., 613 E. Hermitage St., Philadelphia, Pa.

Pittsburgh Section

Associate Member:

Simmers, H. L., Sylvania Electric Products Inc., Pittsburgh, Pa.

Virginia Section

No Elections

GREAT LAKES REGION

Buckeye Chapter

Associate Members:

Schaefer, H. A., Anchor Hocking Glass Corp., Lancaster, Ohio.

Shepard, W. J., Holophane Co., Inc., Newark, Ohio.

Van Steenhoven, F., Holophane Co., Inc., Newark, Ohio.

Central New York Section

No Elections

Cleveland Section

No Elections

Kentuckiana Chapter

No Elections

Miami Valley Section

No Elections

Michigan Section

Associate Members:

Braus, K. G., Gray Electric Co., Detroit, Mich.

Di Pierro, P., Detroit Arsenal, Warren, Mich.

French, B. H., B. H. French Electric Co., Detroit, Mich.

Proudfoot, R. C., Robert C. Proudfoot Inc., Detroit, Mich.

Zolnick, A., Alton Electric Co., Detroit, Mich.

*Upleger, W. G., Thomas Industries, Grosse Pointe, Mich.

Northwestern Ohio Section

No Elections

Ohio Valley Section

Associate Members:

Fraembs, D. H., Formica Corp., Cincinnati, Ohio.

Simmelink, H. W., General Electric Supply Co., Cincinnati, Ohio.

Rochester Section

No Elections

Western Michigan Section

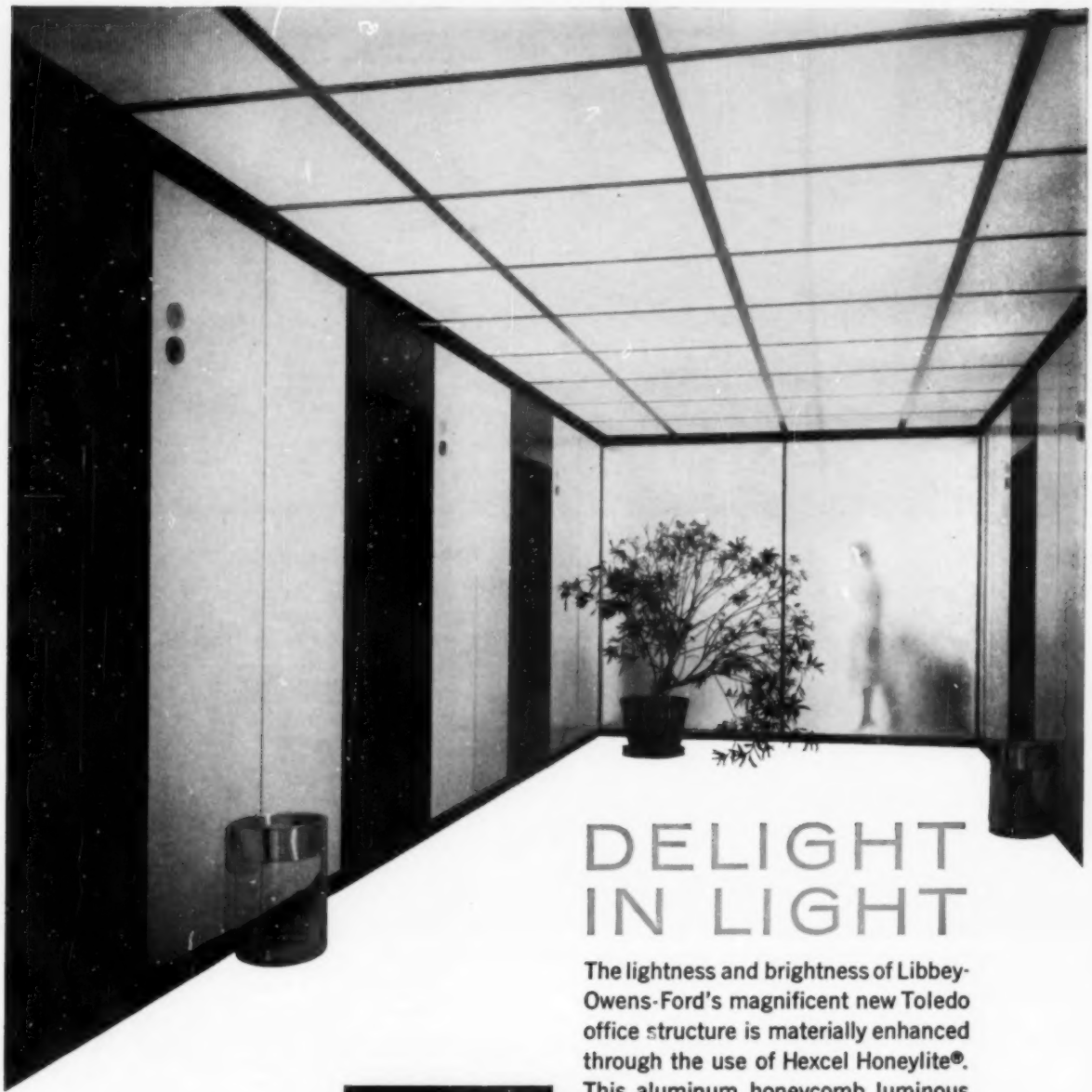
Associate Member:

Thrall, F. J., Purchase Electric Supply Co., Grand Rapids, Mich.

Western New York Section

No Elections

(*Continued on page* 32A)



DELIGHT IN LIGHT

The lightness and brightness of Libbey-Owens-Ford's magnificent new Toledo office structure is materially enhanced through the use of Hexcel Honeylite®. This aluminum honeycomb luminous ceiling system achieves shadow-free, maximum utilization of fluorescent lighting, yet effectively conceals all electrical and mechanical systems. Even air conditioning is installed above the Honeylite panels. All fifteen floors of this installation feature Honeylite ceilings, representing over 120,000 sq. ft. of this totally proven light diffusing system. Owner: Libbey-Owens-Ford, Toledo. Architects: Skidmore, Owings & Merrill. General Contractor: George P. Fuller Company, Electrical Contractor: Rogers Electric, Toledo. For complete Technical Data, send to your nearest Hexcel office.

HEXCEL® PRODUCTS INC.

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Available in Canada through Curtis Lighting, Ltd., Toronto, Ontario

Installations in the News . . .

MERRY CHRISTMAS IN FORT WORTH

Crowning the downtown section of Fort Worth, Texas, last Christmas, was this unique decorative lighting scheme.

Instead of the Santa Clauses and candy canes, Robert J. Blake, Blake Electric Co., and Jack Ford, Texas Electric Service Co., both of Fort Worth, outlined buildings with strings of lamps, creating economical decorations, that harmonized with the locale as well as beautifying it. Merchants were so pleased most left the lighting up an extra six weeks, a few into March. This installation was a joint ALC entry in the North Texas Section.

(*Continued from page* 30A)

INTER-MOUNTAIN REGION

ARIZONA SECTION

Associate Members:
Grommes, W., Demaree & Associates, Phoenix, Ariz.
Maule, J., Graybar Electric Co., Inc., Phoenix, Ariz.

EL PASO CHAPTER

No Elections

NEW MEXICO CHAPTER

Member:
*Peddy, O., Public Service Co. of New Mexico, Albuquerque, N. M.
Associate Member:
Merritt, R. M., Uhl & Lopez, Engineer, Inc., Albuquerque, N. M.

ROCKY MOUNTAIN SECTION

No Elections

UTAH SECTION

Member:
Pollesche, H. H., Intermountain Engineers, Inc., Salt Lake City, Utah.

MIDWEST REGION

CENTRAL KANSAS CHAPTER

Associate Members:
Moore, T. C., Kansas Gas & Electric Co., El Dorado, Kans.
Thornton, V. F., Thornton Electric Co., Wichita, Kans.

CORNHUSKER SECTION

No Elections

HEART OF AMERICA SECTION

Associate Member:
Eagan, W. D., L. S. Gershon & Son, Kansas City, Mo.

ILLINI CHAPTER

No Elections

IOWA SECTION

Associate Members:
Barrigar, D. L., Acme Electric Co., Cedar Rapids, Iowa.
Beckley, J. F., Beckley Electric, Inc., Des Moines, Iowa.
Salkeld, T. J., General Electric Co., Cedar Rapids, Iowa.

OZARK CHAPTER

No Elections

ST. LOUIS SECTION

Associate Members:
Friday, H. E., Union Electric Co., St. Louis, Mo.
Hammond, L. B., General Electric Co., Lamp Division, St. Louis, Mo.
Trapp, A. J., Day-Brite Lighting, Inc., St. Louis, Mo.

NORTH CENTRAL REGION

CENTRAL ILLINOIS CHAPTER

No Elections

CHICAGO SECTION

Associate Members:
Gulvin, G. G., Prescolite Mfg. Corp., Chicago, Ill.
Maroney, W. A., Sola Electric Co., Elk Grove, Ill.
Schultz, S. M., Kralovec & Best, Chicago, Ill.
*Benbow, O. L., Good Manufacturing Co., Chicago, Ill.

INDIANA SECTION

No Elections

MILWAUKEE SECTION

No Elections

TWIN CITY SECTION

Associate Members:
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Franklin, L. J., Westinghouse Electric Supply Co., St. Paul, Minn.
Lambie, R. F., Lambie Electric Corp., Minneapolis, Minn.
Steingraber, C., Commonwealth Electric Co., St. Paul, Minn.

TWIN PORTS CHAPTER

Associate Members:
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Hughes, J. P., Minnesota Power & Light Co., Eveleth, Minn.

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CONNECTICUT SECTION

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Associate Members:
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Dahm, E. D., National Commercial Bank & Trust Co., Albany, N. Y.
Slichko, G., Niagara Mohawk Power Co., Troy, N. Y.

HOUSATONIC CHAPTER

No Elections

NEW ENGLAND SECTION

Member:
*Stawicki, S. W., Champion Lamp Works, Lynn, Mass.
Associate Member:
Blumenthal, A. R., Wasco Products Inc., Cambridge, Mass.

(*Continued on page* 42A)

SAFE *floodlights*

for any explosion-prone area

These incandescent floodlights are explosion-proof and weatherproof . . . ideal for lighting hazardous areas such as this.

*ADDR-12. Dust-ignition-proof floodlight. On aluminum dolly to fit over 33-inch manhole.

**RCDE-8. Explosion-proof incandescent floodlight. Prisms treated to eliminate glare.

***EVH. Explosion-proof hand-lamp. Rain-tight, weather-resistant and easy to re-lamp.

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- Perhaps your problem is dust-ignition-proof floodlighting for dry, dusty, hazardous areas.*
- Possibly you're interested in explosion-proof incandescent floodlights for flush ceiling mounting — something that might be suitable for use in a process control room.**
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Whenever and wherever explosion-proof illumination is needed — whether in fluorescent, mercury vapor or incandescent lamps — Crouse-Hinds has a unit to fit your application need.

Check Catalog 320 for floodlights and Catalog 3000 for hand lamps. Or, see your Crouse-Hinds Distributor.

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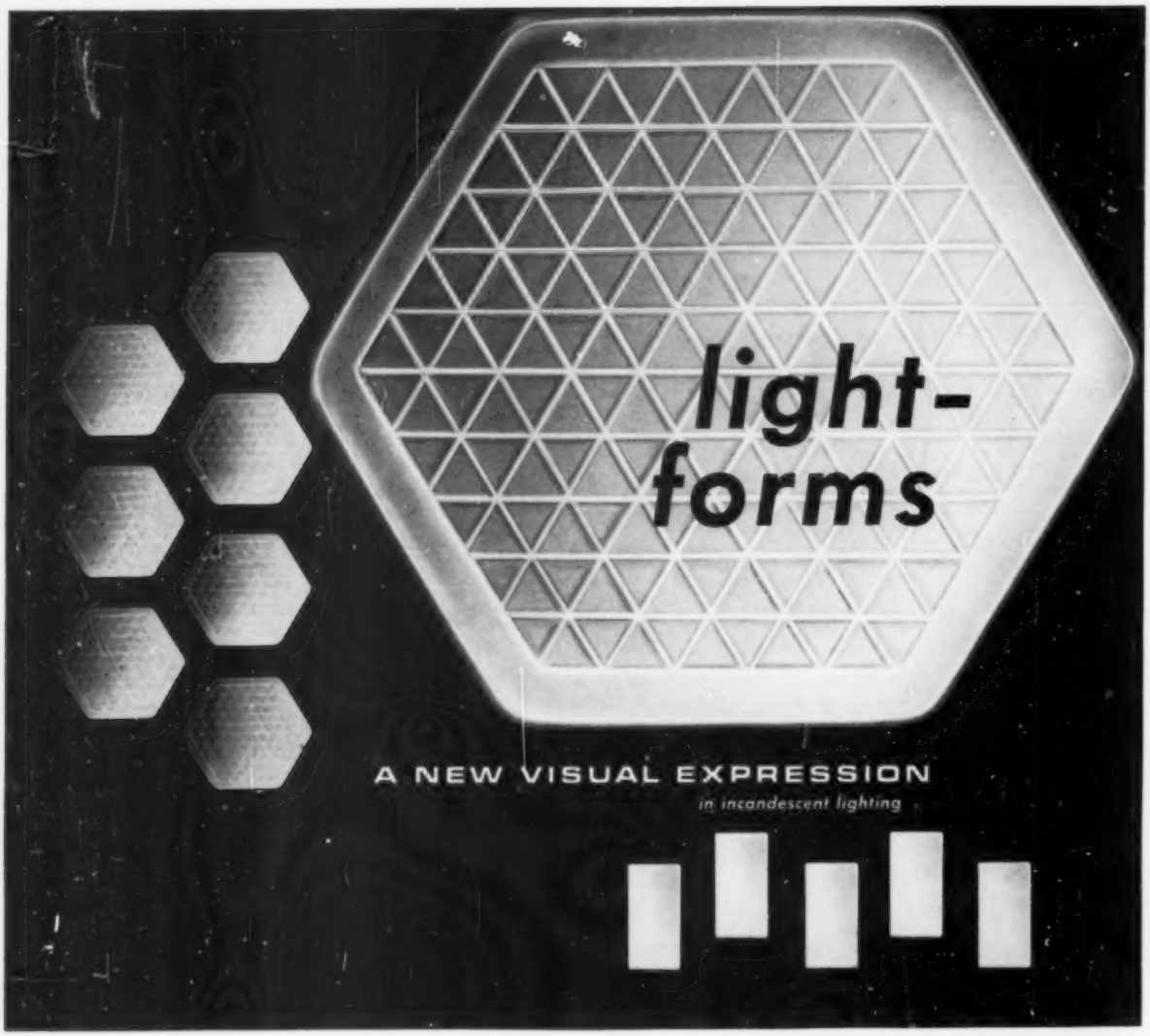
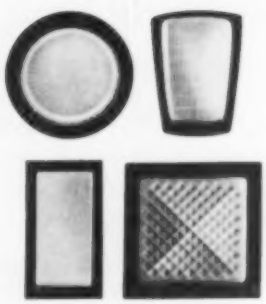
MAIN OFFICE: SYRACUSE, N.Y. **FIELD OFFICES:** Albany, Atlanta, Baton Rouge, Birmingham, Boston, Buffalo, Charlotte, Chicago, Cincinnati, Cleveland, Corpus Christi, Dallas, Denver, Detroit, Houston, Indianapolis, Kansas City, Los Angeles, Milwaukee, Minneapolis, New Orleans, New York, Omaha, Philadelphia, Pittsburgh, Portland, Oregon, St. Louis, St. Paul, Salt Lake City, San Francisco, Seattle, Tampa, Tulsa, Washington. **RESIDENT REPRESENTATIVES:** Baltimore, Md., Meriden, Conn., Reading, Pa., Richmond, Va., Springfield, Mass. **FOREIGN AFFILIATES:** Crouse-Hinds Company of Canada, Ltd., Scarborough, Ont., Crouse-Hinds-Domex, S. A. de C. V. Mexico, D. F. **MANUFACTURING LICENSEE:** Peterco, Sao Paulo, Brazil





Glowing geometric shapes combine the beauty of soft satin handblown glass with all-aluminum construction to provide an unusual combination of decorative effects limited only by the imagination of the designer. ***light-forms*** can be used individually or in combinations of alignment to create patterns of light that become an integral part of the architecture.

Designed for wall use only, ***light-forms*** may be used on either interiors or exteriors.

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Write for Catalog LF-1 or refer to Sweets Catalog File

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Plan to Enter Your Local IES Applied Lighting Competition

Entry Forms are available now from Society Headquarters for 1962 Competition. Send for yours today. Easy rules are on next page.

- **AWARDS**
- **RECOGNITION**
- **SERVICE**
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APPLIED LIGHTING COMPETITION

Go ahead and clip it. Rules are also printed on the inside of the Entry Form.

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Office Manager
Illuminating Engineering Society
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New York 17, N. Y.

Please send me Entry Form for the 1962 IES Applied Lighting Competition. My address is:

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IES Applied Lighting Competition

CLASSIFICATIONS

There are two classifications for entries in the competition. Residential Lighting—interior and/or exterior applications. Commercial, Industrial or any other lighting application as shown in the *IES Lighting Handbook*, Third Edition (Sections 10 to 24). Final decision as to which category an entry may compete in is that of the competition chairman, Local, Regional or National. No contestant may present more than one entry in any one class.

ELIGIBILITY—ENTRY INFORMATION

1. Competition is open to Associates, Members or Fellows of the Society, or members of a Residence Lighting Forum affiliated with the Society.
2. An entry may be made by an individual or by a team.
3. A lighting installation entered in the competition must be completed during the 18 months preceding the local competition.
4. Entries must not have been entered previously in another contest not affiliated with the Society.
5. Where a lighting installation or application is outside the area covered by the Section or Chapter with which the member is affiliated, then only the originator of the lighting design is eligible. Such an entry should be reported to the Regional Vice-President for clearance with the Section or Chapter area involved.
6. Submit entries in the official form folder only. First right of publication within one year (free) is to ILLUMINATING ENGINEERING, the official publication of the Society.
7. For Section or Chapter competition, clear with the competition chairman before completion, to ensure acceptance for presentation. If more entries are submitted than can be presented within the normal time of a meeting, the chairman may request summaries to be submitted so the Board of Judges may rule on their acceptance.
8. No mention, nor identifiable illustration of a specific lighting product name may appear on any part of the presentation.
9. Presentation is limited to ten minutes, with judging penalty for overtime.
10. For visual presentation, contestant may use up to (a) 12 slides (preferably 2- x 2-inch 35-mm color transparencies) (b) 50 feet of film or (c) 8 to 10 large illustrations. For publication, the entry should also include black and white glossy print photographs (preferably not smaller than 5 x 7 inches). In order to provide sufficient time to explain technical aspects, visual presentation should be limited to one third of the total presentation time.

JUDGING

Entries in either classification are judged on:

The Problem—extent of difficulty which the lighting problem presented to the contestant.

The Solution—ingenuity the contestant exercised in solving the installation problem.

Usefulness of the Solution—usefulness to the user and value to Society members as an example of good current lighting practice.

Presentation—organization of the presentation. (Contestants are not judged on oral delivery).

AWARDS

Cash prizes, merit award certificates, and trophies are awarded to the winning entries in each class as follows:

Section and Chapter Competitions

First Prize—$15.00 and Award Certificate.
Second Prize—$10.00 and Award Certificate.
Note: Upon request a duplicate copy of an Award Certificate may be obtained for the owner of an installation.

Regional Conference Competitions

First Prize—$75.00 and Award Certificate. (Winner will be eligible to participate in a $1000 prize fund from the National budget to be allocated among the Regional winners based on the mileage from the Regional Conference city to the National Conference city. This money must be applied for, through the National Applied Lighting Competition Committee and will be granted only to those winners attending the National Conference.
Second Prize—$15.00 and Award Certificate.
Third Prize—$10.00 and Award Certificate.

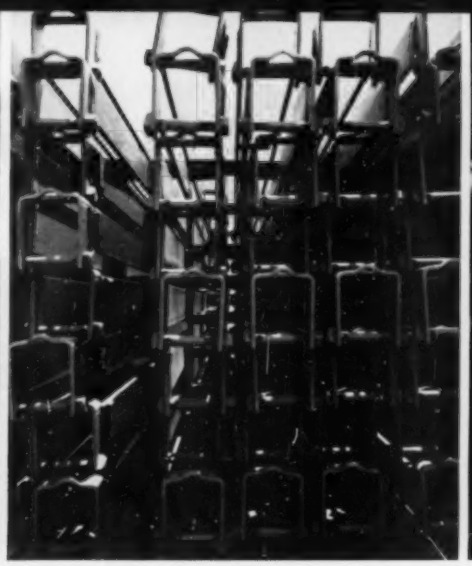
National Technical Conference Competition

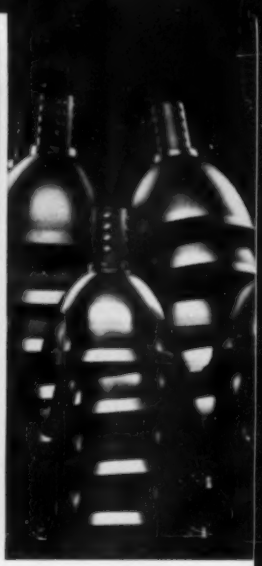
First Prize—$100.00 and Award Certificate.
Second Prize—$50.00 and Award Certificate.
Third Prize—$25.00 and Award Certificate.
Fourth Prize—$15.00 and Award Certificate.

The President Goddard Trophy (silver cup) is presented jointly to the First Prize winners in both classes, and their names are inscribed on the trophy. Silver miniatures of the trophy are presented to these winning contestants in each class, for permanent possession.

NOTE—If a contestant cannot attend a competition (Local, Regional or National), he may select a proxy to present his entry. For the Local Competition, proxy shall be a member of contestant's Section or Chapter; for Regional and National Competitions, a member of the contestant's Region. Contestants in the National Competition are urged to make their presentation themselves or by proxy. If this is not possible, however, an entry may be submitted for presentation on tape recording, on application to the National Committee.

The competition is conducted under a uniform set of rules to assure equality to all participants. In case of doubt as to interpretation of any rule, the decision of the National Competition Committee is final.





Large-scale production in Revere plant plus large inventory of all standard poles, reflectors, fittings and accessories assures prompt availability to fill any demand. Our excellent facilities also permit fast service on special orders for modified or custom-engineered outdoor lighting equipment, available in production quantities for volume users.

What makes Revere the consultant's choice for outdoor lighting?

Revere delivers exactly the equipment you need . . . when you need it

When you choose Revere equipment you can select exactly what's needed with complete confidence that it will be delivered to your job on time. Revere offers consulting electrical engineers and their clients the industry's widest line of outdoor fluorescent, incandescent and mercury luminaires, as well as poles and accessories.

Revere's volume production and large inventory of standard equipment, plus fast service on design and fabrication of custom engineered equipment, eliminates delays. Paperwork is speedily processed, and efficient materials handling systems get the components gathered, loaded and shipped according to your schedule.

An equally important factor makes Revere your most reliable source for outdoor lighting: Revere equipment is built *up* to a quality level, never down to a price level. It delivers performance expected by the most demanding specifiers . . . gives users all the light they pay for in fixtures that outlast even their own expectations.

Write for Revere's outdoor lighting catalog showing our complete line of equipment — *design* matched for best appearance and peak lighting efficiency, and *structurally* matched for strength, balance and trouble-free installation. For information on custom engineered lighting equipment, consult your Revere sales engineer.

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OUTDOOR LIGHTING

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RVR-O-212

Comprehensive Revere catalog makes it easy to select and specify all outdoor lighting components from one reliable source.

Modern handling systems in storage areas and on production lines speeds gathering of components for every job.

Completed orders are loaded and shipped on schedule as a result of efficient production and careful attention to detail.

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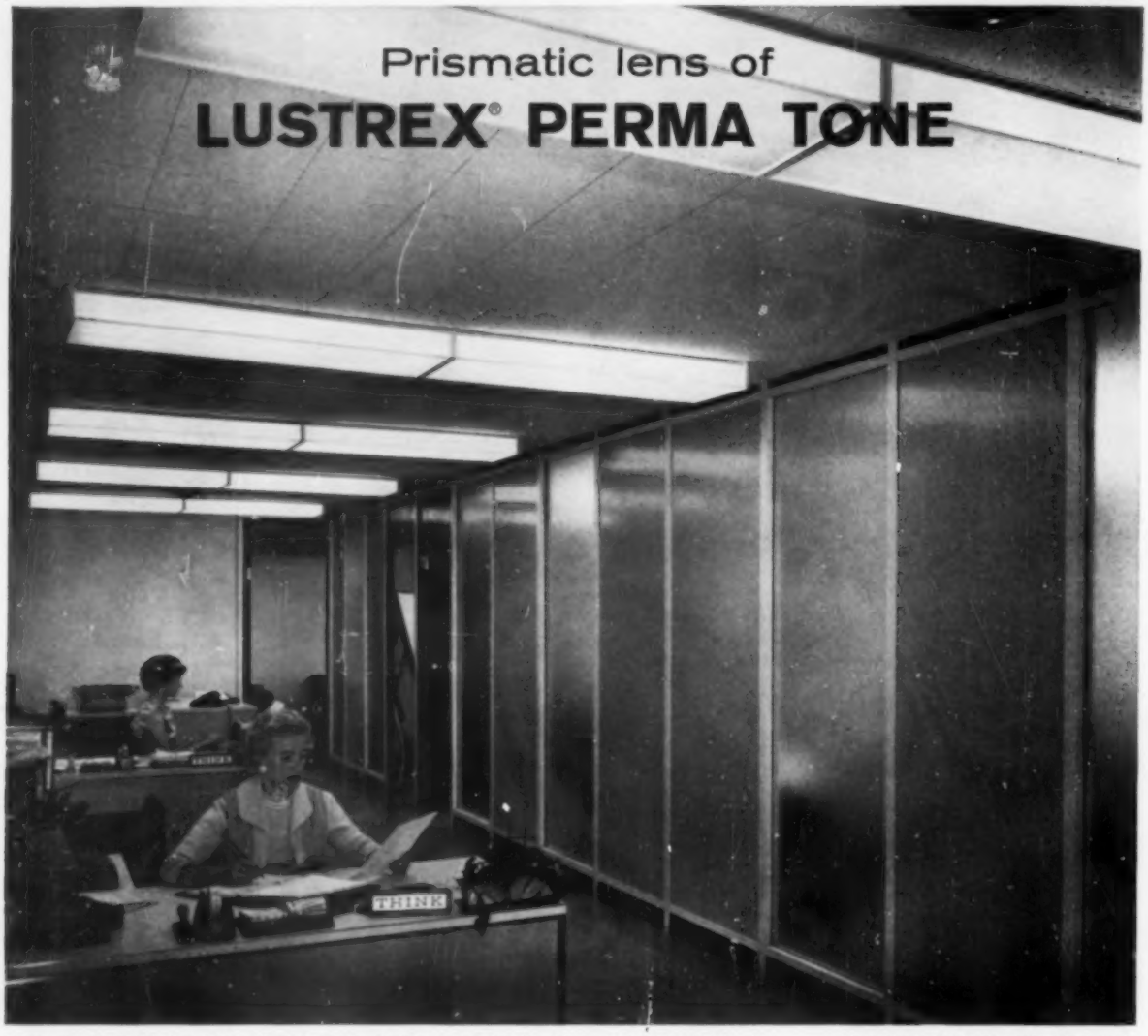
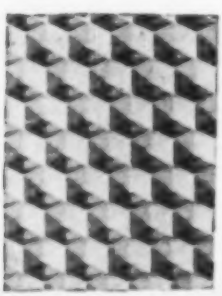


Extruder: The Rotuba Extruders, Division of Waljohn Plastics, Brooklyn, N. Y. Fixture Manufacturer: Work-O-Lite, Belleville, N. J. Photo taken in IBM Building, White Plains, N. Y.



Close-up of prismatic lens pattern made of Lustrex optically engineered into hexagonal pyramids.

More Lustrex perma tone is used for lighting fixtures than any other ultraviolet light-stabilized styrene. In crystal-clear white and a complete color range, perma tone exceeds IES-NEMA-SPI JOINT specifications for ultraviolet light-stabilized styrene. With perma tone you can create low cost areas of illumination with good diffusion, dimensional stability, and uniform light distribution. Use of perma tone assures color stability, 2 to 3 times greater resistance to yellowing under ultraviolet light. Its light weight makes for easier handling, installation and maintenance.

New Impact Lustrex perma tone provides extra toughness and flexibility for snap-fitting to metal parts, high resistance to abnormal abuse, lighter weight through thinner walls. For free, comprehensive technical reports on both general purpose and impact Lustrex perma tone styrene, including accelerated aging test results and other valuable data on styrene in lighting fixtures, write to Monsanto Chemical Company, Plastics Division, Room 1124, Springfield 2, Mass.

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of the

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ENGINEERING SOCIETY

The Publications of the Illuminating Engineering Society listed here summarize the vast amount of research, investigation and discussion of hundreds of qualified members of the Society working on technical committees, and carry the full approval and authority of the Illuminating Engineering Society.

I.E.S. Publications are available, in single copies as priced, to anyone requiring knowledge of the newest in lighting application and the supporting technical information. Should quantities be desired for further distribution, such as for educational or promotional purposes, prices may be obtained by writing Publications Office.

This is your order form. Indicate number of copies ordered before each item; fill in name and address on back of form; enclose check/money order.

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NEWEST of famous I.E.S. Lighting Handbooks. Published March 1959. Over 1100 pages latest information on lighting techniques, applications and theory . . . plus equipment data. Includes all new lighting levels developed from Illuminating Engineering Research Institute studies. All-new index and cross-index. Application sections rearranged for subject headings; 25 sections in all, many new. Complete revision of previous two editions; more comprehensive, easier to use than ever.

Designed for use of lighting engineers and specialists; lighting consultants, architects, designers . . . anyone who plans, installs, or manufactures lighting systems or equipment.

___ **HB-3** **$10**

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I.E.S. RECOMMENDED LIGHTING PRACTICES

These booklets are the complete, standard recommendations for lighting the prescribed areas, and are among the most comprehensive and important of all Society publications. As indicated, some of these recommendations are the work of committees of the American Standards Association, with collaboration by appropriate committees of the I.E.S. All have the approval of the Council of the Illuminating Engineering Society, and are the latest official I.E.S. recommendations.

In general, the information contained in these Recommended Lighting Practices covers completely the area shown in the title. Included in the data are suggested types of lighting systems and luminaires; levels for general lighting and for specific areas; analyses of seeing tasks; and other information essential to lighting the area and of value to lighting engineers and specialists, architects, construction people and others. Each practice is fully illustrated with charts and photographs.

___ **RP-1 Office Lighting** 1960: 36 pp. ..... **50¢**
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___ **RP-6 Sports Lighting** 1961: 48 pp. ..... **50¢**
___ **RP-7 Industrial Lighting (A.S.A.)** 1952: 40 pp. ..... **50¢**
___ **RP-8 Street and Highway Lighting (A.S.A.)** 1953: 32 pp. ..... **50¢**
___ **RP-9 Supplementary Lighting** 1953: 16 pp. ..... **50¢**
___ **RP-10 Protective Lighting (A.S.A.)** 1956: 20 pp. ..... **50¢**
___ **RP-11 Residence Lighting** 1953: 44 pp. **$1.00**
___ **RP-12 Marine Lighting** 1959: 12 pp. ..... **50¢**
___ **RP-13 Outdoor Parking Area Lighting** 1960: 8 pp. ..... **50¢**
___ **RP-14 Airport Service Area Lighting** 1960: 8 pp. ..... **50¢**
___ **RP-15 Recommended Levels of Illumination** 1961: 16 pp. ..... **20¢**

RP-2 (Stores & Other Merchandising Areas), RP-3 (School Lighting) and RP-5 (Daylighting) are out of print. When revised publications are available they will again appear on this list.

I.E.S. COMMITTEE REPORTS

Lighting recommendations based upon studies (research, surveys of current practice, and experimental installations) of I.E.S. Committees and Subcommittees covering all phases of lighting. Completely illustrated, these reports contain detailed information on many lighting problems peculiar to the industry or operation involved as well as providing general data as to lighting systems and luminaires; recommended quantity and quality of illumination; and analyses of specific seeing tasks.

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Each I.E.S. Lighting Data Sheet describes an actual, outstanding lighting installation, complete with photographs, drawings and engineering data. They are published in a series of 24 sheets each year, and current sheets cover such subjects as lighting for metalworking, textile, automobile and other industries; schools; stores; offices; drafting rooms; churches; auditoriums; banks; museums; indoor and outdoor recreational areas; streets and highways; and other special applications.

Printed on heavy gloss paper, punched for standard ring binder, data sheets are an excellent "idea" file for lighting people, consulting engineers and architects; ideal for promotional distribution by manufacturers and electric utilities.

I.E.S. Lighting Data Sheets are delivered throughout each year in groups of eight; three mailings for the entire 24-sheet series. First eight of each series are mailed for delivery in June; second eight in October; final eight in February of following year. Subscription, 24 sheets per set, $1.25; 10 or more sets, $1.00 each. Prices on minimum quantities of 100 individual sheets upon request to Publications Office.

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Special packet showing modern lighting for new and remodelled kitchen and bathroom areas; an important addition to any home lighting idea library.

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Packet featuring outstanding ideas for decorating with light; do-it-yourself instructions for fireplace, wall niche, shelves, drapery wall, etc.

(Sheets in LD-2 and LD-3 not included in annual Series.)

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___ **ED-1 Laboratory Activities with Light** 1959: 42 pp. **$1.00**

Attractively prepared booklet for secondary school students. Supplements physics or science texts with 12 laboratory experiments specifically on light and lighting; easily performed with minimum equipment. Designed to interest young people in lighting and lighting careers.

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Practical outline text covers basic lighting education in 12 lessons including: physics of light and vision; light sources; illumination design and lighting application problems for six different areas. Student learns how to make actual layouts, measurements, analyses. Completely illustrated. Designed primarily for class use and study.

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Glass for lighting

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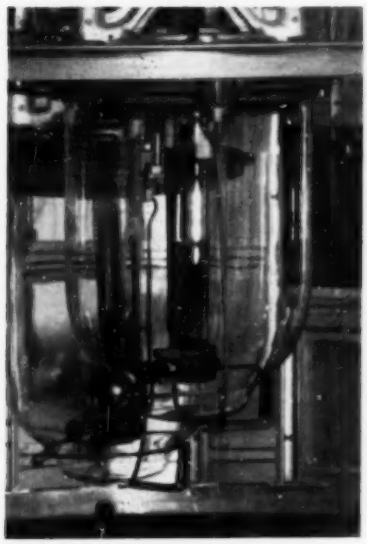

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One of our valued customers is in the interesting business of simulating weather conditions. His apparatus is used widely by manufacturers who have to know how their products will stand up to the elements, and have to know in a hurry.

They park a product sample in the Weather-Ometer* and get the results of a full year of natural North Temperate Zone weathering in a mere 300 hours on the average.

The Weather-Ometer uses a violet carbon arc which approximates noon June sunlight (a light source which nature provides very sparingly even in June). Sprays of water, controlled as to temperature, purity, pressure, and volume, wet the specimen to simulate true weathering.

Enclosing the violet carbon arc is a specially designed PYREX® brand glass globe. This glass filters out the short ultraviolet wave lengths, transmits the others to keep the spectrum similar to noon June sunlight and guard the sample against contamination by products of the arc combustion.

A dependable component in an accelerated duplication of nature at work.

*Trademark of Atlas Electric Devices Co., Chicago, Ill.

ECHOES IN THE INFRARED CHANGE A TRAFFIC SIGNAL

A line of cars passes under a compact little unit and—presto—up ahead a traffic signal changes to green.

The unit, fabricated by another ingenious Corning customer,* consists of two devices. One emits a beam of infrared down toward the pavement, via a special glass lens we supplied. The second device receives the echo as a car passes through the infrared beam. The beam bounces back up through another Corning lens, off a silvered glass reflector (ours, too), and onto a cell which activates the unit. The unit then activates the traffic signal or just keeps track of the traffic.

If you happen to spot one of these devices on a drive and *still* have to stop for a red light, do not despair. That sparkling red roundel safeguarding traffic through the intersection is made by us along with the yellow and green ones, all to rigorous specifications.

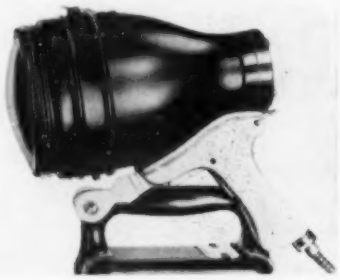
All of which goes to show that we're willing and able to work with you on optical design problems as well as glass design and fabrication.

*Infrared Industries, Waltham, Mass.

THINGS THAT GO GLOW IN THE (APPARENT) DARK

Fluorescence is a happy property of minerals which saves mineralogists many long hours of testing to determine which is which.

It also is a property of many contaminants from which manufacturers like to free their products before they are distributed. Still further, pieces for inspection may be dunked in fluorescent solution and then examined for hairline cracks, etc., which are undesirable.



Fluorescence shows up to best advantage under black light—light from which all but the ultraviolet has been absorbed. Still another of our customers* makes a wide range of black light sources, and we are privileged to help him.

We supply an ultraviolet-transmitting, visible-light-absorbing glass in pressed convex roundels and in tubular form. The roundels are used in mercury lamps, the tubes with fluorescent sources.

Our customer uses this glass in units designed for bench mounting or in units which are handily transportable.

*Black Light Eastern Corp., Port Washington, L.I., N.Y.

OR WHAT HAVE YOU?

Perhaps you have another fish to fry in light transmission or absorption.

We've got other glasses—glasses with extremely good ultraviolet absorption, with extremely good infrared absorption, and, in the other direction, good UV *and* IR transmission.

What are the transmission-absorption factors in your lighting problem? In all probability, we can help. The coupon is a good place to start for more information.

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CORNING GLASS WORKS, 6112 Crystal Street, Corning, N. Y.

Please send me the following:

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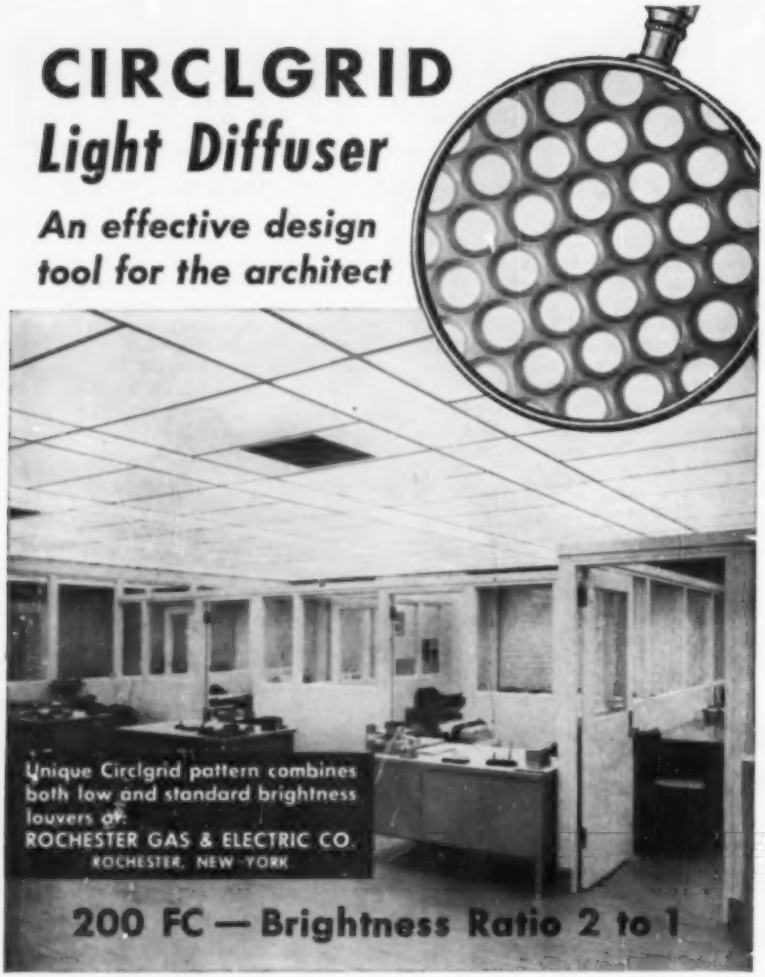
Light Diffuser
An effective design tool for the architect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(*Continued from page 32A*)

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(Continued on page 44A)

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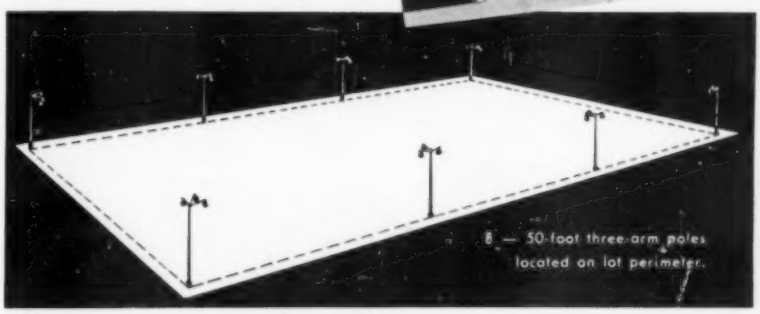

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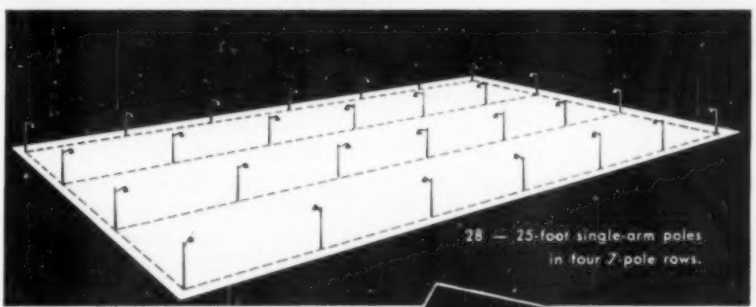

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(*Continued from page 43A*)

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This is a compact, self-contained unit which requires minimum servicing. Full standby power is maintained by automatic built-in charger, which also brings battery back to full capacity after AC power has been restored.

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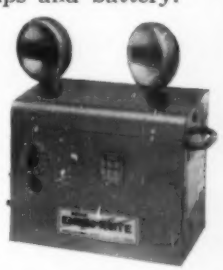

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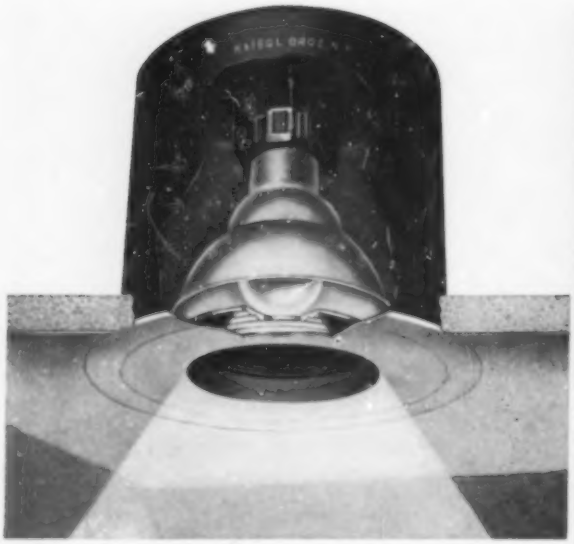

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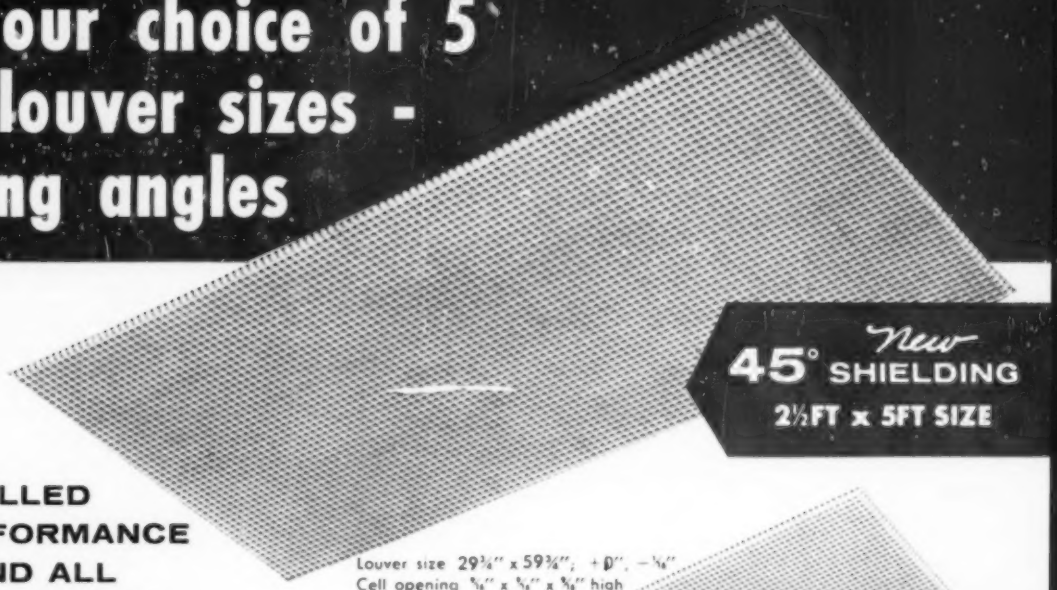

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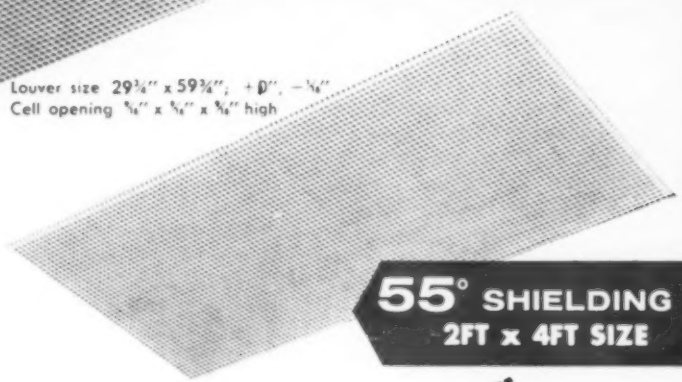
Cell opening ⅝" x ⅝" x ¾" high



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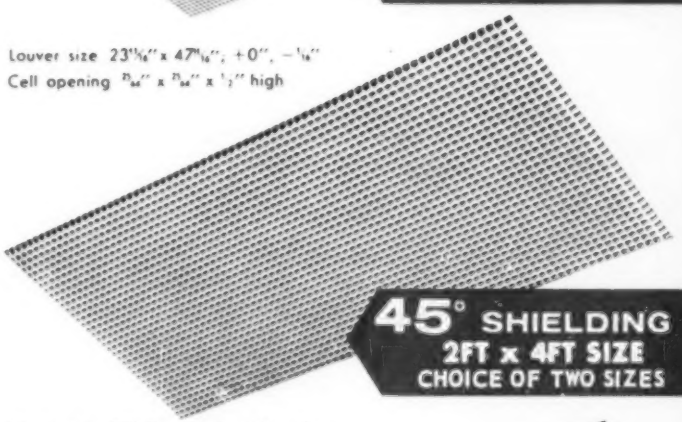
2FT x 4FT SIZE

Louver size 23¹⁵⁄₁₆" x 47¹⁵⁄₁₆"; +0", −⅛"
Cell opening ¹⁵⁄₆₄" x ¹⁵⁄₆₄" x ½" high



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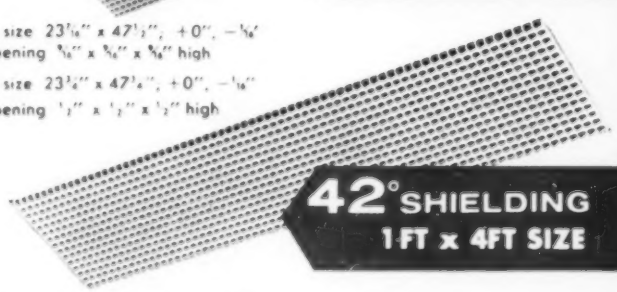
2FT x 4FT SIZE
CHOICE OF TWO SIZES

Louver size 23⅞" x 47½"; +0", −⅛"
Cell opening ⅝" x ⅝" x ¾" high

Louver size 23⅞" x 47⅛"; +0", −⅛"
Cell opening ½" x ½" x ½" high



42° SHIELDING
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Louver size 10¾" x 47¾"; +0", −⅛"
Cell opening ⅜" x ⅜" x ¾" high

american plastic louvers

	Units	Formulation HF 77-1040	ASTM
MECHANICAL			
Tensile Strength	Lbs. per sq. in.	6000-8000	D638-52T
Elongation at Break	Percent	1.0-2.4	D638-52T
Modulus of Elasticity	In tension lbs./sq. in.	4.5 x 10⁵	D638-52T
Hardness	Rockwell	M70-80	D785-51
Flexural Strength	Lbs. per sq. in.	9000-13,000	D790-49T
Deflection at Break	Inches	0.15-0.35	D790-49T
Impact Strength			
½" x ½" Notched	Load ft lbs. per in. of notch	0.25-0.35	D256-47T
½" x ½" Gate End Notched	Load ft lbs. per in. of notch	0.60-0.70	D256-47T
½" x ½" Dead End Notched	Load ft lbs. per in. of notch	0.30-0.40	D256-47T
Machinyze		Average	
THERMAL			
Thermal Expansion	In./in. per °C	6.8 x 10⁻⁵	D696-44
Heat Distortion	1° at 264 psi	183-191	D648-45T
	½" at 6000 psi at 50 °C	110	D621-51
	½" at 3000 psi at 50 °C		D621-51
Deformation Under Load			
OPTICAL			
Light Transmission @ 1000 Foot-candles			
0.050" thick	Percent Transmission @ 550 mu	52	
0.080" thick		38	
0.130" thick		28	
PHYSICAL			
Specific Gravity		1.04-1.06	D792-50
Moisture Absorption	Percent	0.03-0.04	D570-42
Burning Rate (0.050" thick)	In./min.	1	D635-44
ELECTRICAL			
Dissipation Factor	10⁶ cycles	.0001-.0005	D150-47T
Dielectric Constant	10⁶ cycles	2.45-2.65	D150-47T
Dielectric Strength	Volts/Mil. ⅛" thick	400	D149-44
Volume Resistivity	Ohm/cm	10¹⁷	D257-57T

The above data represent average values determined on virgin molding powder under conditions prescribed in ASTM tests conducted in the present range of Lustrex Formulations.

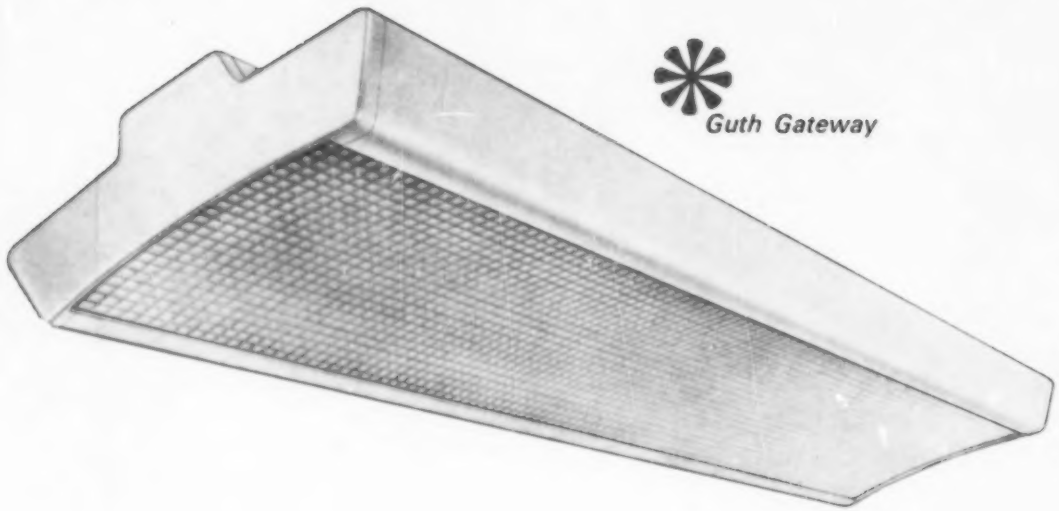
"Lustrex Formulations Reg. U.S. Pat. Off. Monsanto Chemical Company

Available in pastel colors

For pertinent facts on American louvers, write for bulletin 33am and new 3 color catalog—

american louver company

5308 NORTH ELSTON AVENUE • CHICAGO 30, ILL.



Guth Gateway

Sure it looks good, but why specify it?

Gateway's intrinsic beauty is obvious. But that's only half the story. Here is the other half — engineering and construction features that make Gateway worthy of your specification. Gateway is *not* a wrap-a-round. The concave bottom actually hinges separately from the rugged 20-gauge steel ends. Simplifies relamping considerably — one strong panel, not an unwieldy basket, to hinge down.

The steel ends won't warp; also they add extra rigidity to the fixture in continuous-row mountings, or as individual units. (No glue or piano wire holding it together.) The 4′ or 8′, one-piece *tubular* plastic side wings with capped ends (minimize dust and dirt from holding conventions therein) offer greater strength and lower side-brightnesses.

The *concave* Gratelite* bottoms (choice of Prismoid** or Standard Gratelite) are solidly molded with built-in ultra-violet resistant additives. Both Gratelites feature ⅜″ open cubicles — dust and dirt filter thru — doesn't mar beauty.

All the steel parts, including the channel, are formed from electrolytic, *zinc-coated* and phosphatized steel. There's hardly any chance of their rusting regardless of humidity or climate. Each steel part is finished in the new super hard, super efficient *Acrylic* enamel. This is the finish automakers use, and say "never needs polishing". Paint people tell us "it most closely approaches the physical properties of porcelain enamel"

Of course, each unit includes a CBM/ETL Ballast, plus — we heat test Gateways to insure that ballast-case operating temperatures will not exceed 90°C in a 75°F room ambient temperature. (Add these last 13 words to every specification and watch competitors back away!)

Gateway is available in *2, 3 or 4 lamps* — in the same "full-width" fixture — not a corridor looking unit in a carload.

For the final test, write us on your letterhead. We'll have our salesman show you a "live" demonstration of Gateway. If you just don't like salesmen, write us and we'll send our Gateway Brochure. In either case, you'll like Gateway, a fixture that proves itself.

Guth LIGHTING since 1902

THE EDWIN F. GUTH CO., 2615 WASHINGTON BLVD., BOX 7079, ST. LOUIS 77, MO.

* ® U.S. PAT. NO. 2,745,001 — CAN. PAT. 1957, NO. 538,245 — ** ® U.S. PAT. NO. 2,904,673